VOL. 5 NO. 23
December, 1980

Energy Research Abstracts

ABSTRACTS 35862-37459

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications are regularly issued which are comprehensive in their coverage of certain energy fields. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

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Fusion Energy Update

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Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

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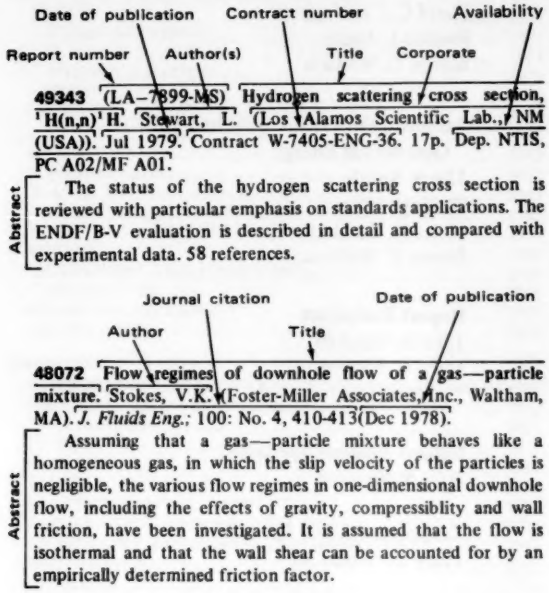
Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.
Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
LA-tr-		
78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

35862 (FE—2286-60) **Preparation of a coal conversion systems technical data book. Project 61003 quarterly report, November 1, 1979-January 31, 1980.** (Institute of Gas Technology, Chicago, IL (USA)). Aug 1980. Contract AC01-76ET10255. 225p. NTIS, PC A10/MF A01.

Comparison results of evaluations on the SURFIMP program with experimental quaternary data on the NH_3-CO_2-H_2S-H_2O system are presented. Physical and thermodynamic properties of Furan and Tetrahydrofuran are presented both in SI and British units. The heating values and compositions of coal and char analyzed at IGT for the HYGAS program have been correlated. The standard deviation of the prediction, using the resulting correlation, is about 85 Btu/lb. Results from the literature on the carbon-carbon dioxide reaction rates have been collected, evaluated and tabulated. The forms of carbon used in the reaction studies included: char, coke, graphite, carbon black, etc. The reaction temperature and pressure ranges from 700 to 1600°C and from subatmospheric pressure to 36 atmospheres, respectively. Atmospheric fluidized bed boiler, pressurized fluidized bed boiler, combined open gas-steam turbine cycle with integrated low-Btu gasifier, combined gas-steam turbine cycle using coal derived liquid fuel-potassium topping/steam bottoming cycle-pressurized fluidized bed boiler, and closed cycle gas turbine-helium/organic bottoming-atmospheric fluidized bed boiler were analyzed using thermodynamic availability functions. The availability efficiency and effectiveness of these processes are reported. An attrition mathematical model which is used for predicting the changes in particle size distribution in a fluidized bed reactor has been proposed.

PROCESSING

REFER ALSO TO CITATION(S) 36988

CARBONIZATION

35863 **Preparation of carbonaceous products.** Fukuda, K.; Murakami, H.; Ohnishi, N.; Ohtsubo, T. (to Mitsui Coke Co Ltd (Japan); Mitsui Mining Co Ltd (Japan)). US Patent 4,210,517. 1 Jul 1980. Priority date 31 Oct 1977, Japan, vpp.

A description is given of a process for the preparation of a green coke having a structure selected from the group consisting of needle-like, coarse-mosaic, mosaic, fine mosaic and glassy, wherein coal is dissolved in a hydrocarbon solvent to form a solution of coal having a predetermined degree of depolymerization, residual insoluble components are separated from said solution, said solvent is removed therefrom to yield a solvent purified coal useful as a raw material for said green coke, and said solvent purified coal is coken to form said green coke, the improvement wherein said solvent purified coal is selected from the group consisting of a first type of solvent purified coal useful as a raw material for structurally needle-like green coke and characterized by a (N+O+S)/C atomic ratio of less than 0445, a second type of solvent purified coal useful as a raw material for structurally coarse mosaic green coke and characterized by a (N+O+S)/C atomic ratio of from 0.0445 to but excluding 0.0516, a third type of solvent purified coal useful as a raw material for structurally mosaic green coke and characterized by a (N+O+S)/C atomic ratio of from 0.0516 to but excluding 0.0584, a fourth type of solvent purified coal useful as a raw material for structurally fine mosaic green coke and characterized by a (N+o+s)/ C atomic ratio of from 0.0584 to but excluding 0.0645, and a fifth type of solvent purified coa L useful as a raw material for structurally glassy green coke and characterized by a (N+O+S)/C atomic ratio equal to or greater than 0.0645.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 35908, 35973

35864 (BNL—51235) **Regenerative process for desulfurization of high temperature combustion and fuel gases. Progress report No. 15, January 1-March 31, 1980.** Albanese, A.S.; Sethi, D.S. (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01.

A new regenerative sorbent process for desulfurizing fluidized-bed combustion gases is presented. The sorbent was developed by Brookhaven National Laboratory and is prepared from commercial silicate bearing portland cement. The chemical reactions and mechanical procedures involved in preparing the sorbent, in desulfurizing the flue gas, in regenerating the spent sorbent, and in producing elemental sulfur from the regenerator product gas are discussed. The performance of natural limestone sorbents is compared with that of portland cement pellets in each of the above operations. Conceptual engineering designs and cost data for atmospheric fluidized-bed (AFB) power generation plants using limestone and portland cement sorbents are also presented. Cost and limestone process data were obtained from US Government publication PRS-23 EPA-600/7-77-126 which was prepared by General Electric, Bechtel and Foster Wheeler Energy Corporations and the Tennessee Valley Authority. The results of our analyses indicate that the cost of generating electricity by a regenerative portland cement sorbent plant would be about 12% lower than for once-through limestone AFB plants, about 17% lower than conventional power plants using wet limestone scrubbers and about 12% lower than regenerative magnesium oxide (MgO) scrubber plants.

35865 **Removal of sulfur compounds from coal during pipeline transport .** Titus, P. (to Shell Oil Co). US Patent 4,210,422. 1 Jul 1980. Filed date 26 Dec 1978. vpp.

A description is given of a process for removal of sulfer compounds from coal during preparation of the coal for pipeline transport and pipeline transport of the coal, comprising: storing the coal in contact with oxygenated water for 1 to 7 days; preparing the coal in particles suficiently fine for transport as an aqueous slurry; mixing the coal particles with oxygenated water and a basic chemical substance selected from the group consisting of calcium carbonates, sodium hydroxide, ammonium hydroxide, ammonia, and sodium carbonate; transporting the coal as a slurry in a pipeline; and separating the coal form water containing soluble sulfur compounds and from sludge-containing insoluble sulfur compounds.

35866 **Method for increasing the hydrogen sulphide concentration in an acid gas.** Braam, J.; Verloop, J. (to Shell Oil Co). US Patent 4,210,627. 1 Jul 1980. Priority date 4 Feb 1977, Netherlands, vpp.

A process for the removal of H^2S and CO^2 from a gas stream comprising: (A) measuring the flow of the gas stream to produce a value representing the magnitude of the gas stream, (B) contacting said gas stream with a iquid regenerable absorbent in an absorber to absorb H^2S and CO^2 from the gas stream and producing a loaded absorbent solution, (C) regenerating the loaded absorbent solution ina regnerator ot produce an acid gas stream containing H^2S and CO^2, and an absorbent solution, (D) comparing the value representing the magnitue of gas stream entering the absorber of step (A) with a predetermined value, and, if this value is smaller than a predetermined value, passing a portion of the acid gas stream to a second selective absorber, the second absorber being maintained under conditions to absorb H^2S and reject CO^2 and the absorbent solution being a portion of that regenerated from the regenerator, (E) returning loaded absorbent solution from the second selective absorber to

the regenerator, and (F) regenerating the loaded absorbent solutions from steps (C) and (E) to produce an acid gas having an increased H^2S concentration.

HYDROGENATION

REFER ALSO TO CITATION(S) 36001

GASIFICATION

REFER ALSO TO CITATION(S) 35893, 35999, 36000, 36608, 36621, 36801, 36954, 36966, 36995

35867 (BNL—51233) **Alternative process schemes for coal conversion. Progress report No. 4, September 1, 1979-March 30, 1980.** Sansone, M.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 50p. NTIS, PC A03/MF A01.

This progress report is divided into two parts. In Part A, the results of the first three progress reports which dealt with the separation of H_2/CH_4 and $H_2/CH_4/CO$ mixtures resulting from coal gasification processes are briefly summarized. The separation calculations were performed for ideal, cryogenic, clathrate (gas-hydrate), and absorption/stripping separation processes. The cryogenic separation indicates the least energy requirement. Work on this phase of the program has been concluded. An experimental coal gasification program is being undertaken. In Part B, a review smmary of existing and developing coal gasificaton processes is presented. The relative merits of gasifier type, heating method, operating mode, process conditions, and gasifying medium are considered. This is followed by a qualitative appraisal of several selected coal gasification processes based upon the above considerations. It is intended that this report will help focus attention on those areas in which significant process improvements can be realized. The report concludes with a series of recommendations for future work.

35868 (CONF-780891—4) **TVA ammonia from coal project.** Waitzman, D.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). 1978. 11p. NTIS, PC A02/MF A01.

From 5. annual international conference on coal gasification, liquefaction, and conversion to electricity; Pittsburgh, PA, USA (1 Aug 1978).

The TVA Ammonia from Coal Project consists of retrofitting an 8 ton/hour coal gasification and gas purification facility onto the front end of a small, but modern, natural gas-steam reforming ammonia plant at the National Fertilizer Development Center in Muscle Shoals, Alabama. Practically all nitrogen fertilizer is made from ammonia. Ninety-five percent of the ammonia produced is made from natural gas. If we lose the natural gas, we lose the ammonia, the fertilizer, and one-third of the food and fiber produced. Neither this country nor the world can stand such a situation. The substitutes for natural gas that can be considered are naphtha, fuel oil, and coal. Availability and cost considerations are such that coal is the only viable alternative. The main objective of the TVA project is to provide technical and economic information to the US fertilizer industry for the substitution of coal for natural gas as a feedstock for producing ammonia. The TVA demonstration facility should provide a basis for retrofitting existing plants. There are about one hundred natural gas-steam reforming plants in the US and about thirty of these are large 1000 ton/day plants. If these plants can be retrofitted so that they can use coal, the present investments in these plants can be protected. Many of the problems involved in retrofitting are different from those with grass-roots plants. Others, such as th W.R. Grace Company, are pursuing grass-roots ammonia from coal technology, and we believe grass-roots and retrofit approaches supplement each other and both approaches should be pursued. Much of the data from the TVA project will be applicable to grass-roots plants. The Texaco coal gasification process was selected for the TVA project, but it is apparent that a number of processes are entirely adequate for use in ammonia from coal plants.

35869 (CONF-800957—1) **Interpreting the factors related to groundwater impact assessment of coal conversion solid wastes.** Ketelle, R.H.; Triegel, E.K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From 3. annual Madison conference of applied research and practice on municipal and industrial waste; Madison, WI, USA (10 Sep 1980).

Oak Ridge National Laboratory is currently involved in the assessment of environmental impacts of five proposed coal conversion demonstration facilities. One of the primary areas of concern in demonstrating the environmental acceptability of the technology is the issue of solid waste disposal. Such concern is related to both regulatory compliance and the prevention of groundwater and surface water contamination. This paper presents an overview of the actual information available for the various projects and the techniques used to interpret the data. Analysis of the potential impacts and design of mitigating measures is based in large part on the information developed during this initial period of assessment and data collection. The methods used in the analyses are discussed in terms of the geology and hydrology of one of the sites, the alterations of the baseline monitoring plans imposed by geologic constraints and the feasibility of using certain techniques such as computer modeling.

35870 (DOE/ER/10468—1) **Fundamental studies of erosion for coal gasification systems. Annual progress report, 1 November 1979-30 June 1980.** Follansbee, P.S.; Sinclair, G.B.; Williams, J.C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 27 Jul 1980. Contract AC02-79ER10468. 45p. NTIS, PC A03/MF A01.

The effort in this program is divided between modelling the particle impact event using numerical methods and computer calculations and actual measurement of erosion rates. While the results obtained from each of these activities must be combined to provide an improved understanding of particulate erosion of ductile materials, it is convenient to describe separately the progress in each activity area. The first step in the application of the finite element method to any problem is the dissolution of the continuum into small elements. The intent of this procedure is to use as few total elements as possible and to make the elements small where gradients are large and vice versa. The exact solution for the contact of a rigid cylinder with an elastic surface is available from Hertz. This solution has been compared with the computer results obtained from finite element maps containing 148, 273, and 474 elements. The correlation between the computer results and elastic solution is not good for the map with the fewest elements, but improves as the number of elements increases. Convergence to this exact solution has been examined as a function of the number of map elements as a means of improving the efficiency of the design process used to obtain the maps. Having done this, the next step was to include the effects of plasticity. In order to validate the model, the measurement of erosion rates and observation of damage on eroded samples is necessary. Since it takes billions of impacts to lead to measurable weight loss, the experiment must be carefully designed to assure meaningful results. Three facets of the experimental portion of this study are described: the construction of the erosion apparatus, the characterization of the erosion environment and the preliminary erosion results.

35871 (DOE/ET/10692—T1) **Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres. Final report.** Douglass, D.L.; Bhide, V.S.; Vineberg, E. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). May 1980. Contract AT03-76ET10692. 96p. NTIS, PC A05/MF A01.

Six alloys, 310 stainless steel, Hastelloy X, Inconel 671, Incoloy 800, Haynes 188, and FeCrAlY (GE1541 and MA956), were corroded in two chars at 1600 and 1800°F. The chars, FMC and Husky, contained 2.7 and 0.9% sulfur, respectively. Various parameters were investigated, including char size, cover gas, char quantity, char replenishment period, gas composition, and the use of coatings. The corrosion process was strictly sulfidation when the char was replenished every 24 hours or less. The kinetics of reaction were nearly linear with time. The reaction resulted in thick external sulfide scales with extensive internal sulfidation in the substrate. The kinetics and reaction-product morphologies suggested that diffusion through the sulfide scale played a minor role and that an interfacial reaction was the rate-controlling step. A mathematical model was developed which supported this hypothesis. The reaction rates showed a relatively minor role on alloy composition, depending upon whether the alloys were tested singularly or in combination with others. Inconel 671, the best alloy in CGA environments, consistently corroded the most rapidly of the chromia-former types regardless of char sulfur content or of the temperature. Type 310 stainless was marginally better than Inconel 671. Incoloy 800 was intermediate, whereas, Haynes 188 and Hastelloy X exhibited the best corrosion resistance. The FeCrAlY alloys reacted very rapidly in the absence of preoxidation treatments. All alloys corroded in char at least 1000 times more rapidly than in the CGA (MPC-ITTRI) environment. None of the alloys will be acceptable for use in contact with char unless coatings are applied.

35872 (DOE/ET/10698—T1) **Effect of preoxidation on the corrosion of some alloys in coal chars and sulfur vapor. Final report.** Douglass, D.L.; Sheybany, S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). May 1980. Contract AT03-76ET10698. 41p. NTIS, PC A03/MF A01.

Preoxidation of several chromia-former and of several alumina-former alloys at temperatures ranging from 1800 to 2300°F in either water-saturated argon or in air was performed prior to corrosion in coal char or in sulfur vapor. Chromia films offered no protection to sulfidation in both char and sulfur vapor environments. The chromia films were adherent but permitted rapid inward penetration of sulfur and outward penetration of cations to form extensive sulfides. Alumina films offered protection for much longer times than chromia films but localized cracking and/or spalling of the alumina permitted rapid attack at the exposed areas. The addition of yttrium as either a metallic element or as an oxide dispersion

improved the mechanical stability of the films and prolonged the period of protectiveness. A binary alloy, Fe-13Al, sulfidized more raidly after preoxidation than before preoxidation. Alumina films would provide an excellent protective barrier if thick, crack-free films could be grown at reasonable temperatures. The low growth rates at very high temperatures and the susceptibility of alumina films to crack and spall during thermal cycling suggest that preoxidation will not offer adequate corrosion resistance for alloys exposed to char in goal gasifiers.

35873 (DOE/ET/14696—T3) **Peat Biogasification Development Program. Quarterly progress report No. 3, April 1-June 30, 1980.** Wise, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). 1980. Contract AC01-79ET14696. 106p. NTIS, PC A06/MF A01.

Procedures for High Pressure Liquid Chromatography (HPLC) are under development that will identify and quantify fermentable material contained in pretreated peat liquors. Several of the model compounds hypothesized to be a product of peat pretreatment have been identified with HPLC and confirmed with Thin Layer Chromatography (TLC). However, there are numerous unknown peaks of other products for which elution times and extinction coefficients must be determined in order to make HPLC a quantitative analytical tool for kinetic data.

35874 (DOE/PETC/TR—80/7) **Methanation in catalyst-sprayed tube wall reactors: a review.** Pennline, H.W.; Schehl, R.R.; Haynes, W.P.; Forney, A.J. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Sep 1980. 31p. NTIS, PC A03/MF A01.

The design and operation of catalyst-sprayed tube wall reactors for methanation are discussed. Reactor tubes were either coated on the inner surface or on the outer surface with a Raney nickel catalyst. A liquid coolant, which was opposite the catalyst-reactant gas-side, removed the heat of methanation. Catalyst performance, reactor operating conditions, spent catalyst analyses, and other results are presented for five PDU tests.

35875 (EPRI-AP—1508) **Design properties of steels for coal conversion vessels: report on long-term testing.** McCabe, D.E.; Landes, J.D. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Sep 1980. 48p. NTIS, PC A03/MF A01.

This interim report describes the results of fracture toughness measurements made in simulated coal conversion environments, utilizing specimens held under sustained load or sustained deflection for six months. Planned coal conversion techniques involve internal pressures as high as 25 MPa and metal temperatures as high as 727°K. The product streams will contain various amounts of CO, CO_2, H_2O, NH_3, H_2S, and H_2. Under these conditions, structural steels may be degraded by deleterious interactions between the steels and the environments. The only design basis available at present, for pressure vessels operating in high-pressure, high-temperature hydrogenous environments, is the empirical Nelson diagram approach used by the petrochemical industry. The present problem was undertaken, therefore, to develop a quantitative fracture mechanics base for 2 1/4 Cr-1 Mo steel, with a variety of metallurgical and environmental conditions that may be typically encountered in coal liquefaction and gasification. The present report deals only with the results of the long-time, sustained deflection tests and the sustained load tests. The main thrust of the results seems to be that the fracture toughness of the steels is not degraded appreciably at the elevated temperatures, due to exposure to hydrogenous environments; such exposure, however, results in a significant loss of the room-temperature fracture toughness, due to embrittlement by retained hydrogen. There is some evidence that creep- and stress-relation processes may be more important at 727°K (800°F) than prior experience with the steel might indicate.

35876 (FE—1792-61) **Coal feeder development program. Phase III report.** (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). Sep 1979. Contract AC01-76ET10260. 392p. NTIS, PC A17/MF A01.

As a result of the work carried out in Phases I and II, the Kinetic Extruder was selected for further development during Phase III. Design studies were performed to identify components of the Kinetic Extruder which had an important impact on performance. These components were optimized and subjected to testing in the coal feeder test loop. The improved components were incorporated in the design of the Kinetic Extruder, Model No. 3, which was successfully tested up to 400 psig. The Kinetic Extruder Model No. 4 was designed to incorporate low differential pressure seals and provision for fluidic turndown control. This machine is ready for testing and engineering evaluation.

35877 (FE—2030-TR-12) **Thermochemistry and kinetics of oxygen interaction with microporous chars. Technical report 12.** Ismail, I.M.K.; Walker, P.L. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Jan 1979. Contract EX-76-C-01-2030. 234p. NTIS, PC A11/MF A01.

In processes involving the hydrogasification of coal, the coal is first exposed to hydrogen at elevated temperatures and pressures during which devolatilization and gasification of the more reactive parts of the coal occur. A microporous coal char, which is relatively unreactive, is also produced. The char, in turn, can be reacted with steam to generate the hydrogen needed in the first part of the process. Or the char, in part, can be used in a boiler to raise steam. In any case, characterization of coal chars and the relation of character to behavior during gasification and/or combustion is important. This report is primarily concerned with laying the experimental base for the measurement of the heat of interaction of a gas (oxygen in this case) with chars. Following the laying of this base, using a char produced from a reproducible polymer system, heats of interaction of oxygen with chars produced from American coals, ranging in rank from anthracite to lignite, were measured. Differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA) were used to study the exothermicity and kinetics of interaction between Saran chars and oxygen at selected isothermal temperatures in the range 75 to 850°C. The combination of measuring heats of oxygen interaction with chars (using the DSC technique) and weight changes during the interaction opens up a valuable new technique to characterize coal chars. Heats of interaction at 100°C are found to be related to rates of char gasification at higher temperatures. Both heats of interaction and gasification rates are, in turn, seen to increase sharply as the rank of coal from which the char is produced is decreased.

35878 (FE—2777-1) **Exxon catalytic coal gasification process development program. Quarterly technical progress report, July 1-September 30, 1978.** (Exxon Research and Engineering Co., Baytown, TX (USA)). Nov 1978. Contract ET-78-C-01-2777. 19p. NTIS, PC A02/MF A01.

This report covers the activities for the Exxon Catalytic Coal Gasification Development Program during the quarter from July 1-September 30, 1978. The separation of the char-lime residue from the recovered potassium solution in the catalyst recovery system has been identified as a troublesome step in pilot plant operations. Many of the char-lime particles are smaller than 10 microns, and the effective density of the char particles is close to that of the recovered potassium solution. Promising approaches for improving this separation have been identified. The present kinetic model for catalytic gasification is based almost entirely on data from devolatilized coal at 1300°F and some limited data at 1200°F. Plans have been made to expand the data base to include the gasification kinetics of steady state char from the fluid bed gasifier (FBG) to determine the effect of carbon conversion on reaction rate and to better define the effect of temperature. Engineering cost reduction studies have identified a potential economic incentive to reduce the methane content of the recycle gas stream below the 10% CH_4 level in the current study. This step would require more cryogenic refrigeration but would significantly reduce the amount of recycle gas, reduce the offsite stream required, and reduce the gas feed to acid gas recovery. A more detailed study is planned. An additional incentive study has begun to determine the potential for a cryogenic separation system to remove the acid gases from the product gas. Since the acid gas separation system makes up about 15% of the gas cost, savings here could be very beneficial.

35879 (FE—2777-T1) **Exxon catalytic coal gasification process development program. Quarterly technical progress report, October 1-December 31, 1978.** (Exxon Research and Engineering Co., Baytown, TX (USA)). Feb 1979. Contract ET-78-C-01-2777. 55p. NTIS, PC A04/MF A01.

This report covers the activities for the Exxon Catalytic Coal Gasification Development Program during the quarter October 1 to December 31, 1978. Construction of three bench scale units to study catalyst recovery was begun. These units include a one-gallon stirred tank for char digestion studies, a series of leaching tanks for char-liquid separation studies, and a fluidized bed reactor for char combustion studies. Construction of a bench unit to study cryogenic separation of CO_2 from product gas was also begun. In addition, the construction of a bench apparatus to study reactions of product and recycle gas in furnace and heat exchanger tubes was started. The 1/4 ton/day Fluid Bed Gasifier was operated to produce char for the Process Development Unit (PDU) startup and catalyst recovery studies. Construction of a single stage catalyst recovery pilot plant was completed. This unit was built to test a proposed catalyst recovery system for the Process Development Unit (PDU). The design of the on-line data acquisition system for the PDU was completed. A fixed-bed bench scale gasification unit has been recommissioned to better define catalytic gasification kinetics. Work continued on a revised offsites facilities definition and cost estimate to update the CCG Commercial Plant Study Design. Work continued also on the study to determine the incentives and data needs for a cryogenic separation system to remove acid gases from the product gas.

35880 (MTCH-PR—6-79) **In-situ coal conversion.** (Mining Technology Clearing House, Tamworth, Staffordshire (UK)). 1979. 17p. NTIS, PC A02/MF A01.

35881 (ORNL/EIS—169) **Environmental Compliance Program Handbook: Illinois.** Huffstetler, J.; Collier, B.N.; D'Amico, A.; Gross, C.; McAfee, N.; Brown, K. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 330p. NTIS, PC A15/MF A01.

The US Department of Energy (DOE) has provided funding for a study of a coal conversion demonstration facility that may be located in the State of Illinois. This handbook identifies those Illinois environmental laws, administrative rules and regulations, and permitting procedures that could affect the siting, construction, or operation of such a facility. Areas of primary concern include air quaity, water quality, solid waste disposal, and hazardous waste disposal. All entries are part of a computerized data base built and maintained for DOE at Oak Ridge National Laboratory.

35882 Process for gasifying carbonaceous material from a recycled condensate slurry. Forney, A.J.; Haynes, W.P. (to Dept. of Energy). US Patent Application 074,352. 10 Sep 1979. 12p.

Coal or other carbonaceous material is gasified by reaction with steam and oxygen in a manner to minimize the problems of effluent water stream disposal. The condensate water from the product gas is recycled to slurry the coal feed, and the amount of additional water or steam added for cooling or heating is minimized and preferably kept to a level of about that required to react with the carbonaceous material in the gasification reaction. The gasification is performed in a pressurized fluidized bed with the coal fed in a water slurry and preheated or vaporized by indirect heat exchange contact with product gas and recycled steam. The carbonaceous material is conveyed in a gas-solid mixture from bottom to top of the pressurized fluidized bed gasifier with the solids removed from the product gas and recycled steam in a supported moving bed filter of the resulting carbonaceous char. Steam is condensed from the product gas and the condensate recycled to form a slurry with the feed coal carbonaceous particles.

35883 Kinetics of coal gasification: a compilation of research. Johnson, J.L. (Comp.). New York, NY; John Wiley and Sons (1979). 337p.

This book includes discussion of fundamental aspects of coal gasification that have been developed in the many investigations conducted during the past 15 to 20 years in the areas of thermodynamics, physics, and chemical kinetics. The discussion of thermodynamics and kinetics extend to coal-char gasification as well as to the initial coal-gasification processes in which volatile matter is evolved and the coal char is formed. The text is divided into 6 chapters entitled: Fundamentals of Coal Gasification; Kinetics of Coal Gasification in Hydrogen During Initial Reaction Stages; Gasification of Montana Lignite in Hydrogen and Helium During Initial Reaction Stages; Relationship Between Gasification Reactivities of Coal Char and Physical and Chemical Properties of Coal and Coal Char; The Use of Catalysts in Coal Gasification; and Kinetics of Bituminous Coal Char Gasification With Gases Containing Steam and Hydrogen. (BLM)

35884 (UCRL-Trans—11617) **First data on underground coal gasification at the experimental gas generator of the Angren Podzemgaz Station.** Nusinov, G.O.; Zybalova, G.P. Translated from *Podzemn. Gazif. Uglei;* **6**: 3-10(1962). 16p. NTIS, PC A02/MF A01.

The following conclusions were developed from this field test: The low gas permeability of the coal seam and the tendency of the coal toward self-ignition restrict the use of percolation linkage of boreholes at the Angren Podzemgaz Station. The method of hydraulic fracture of the coal seam at Angren can effect an increase in rate and improvement of the flow indices of the linking process. When hydraulic fracture was carried out wih a water supply rate of 2 m^3/min, channels were formed linkage of which was carried out mainly with medium-pressure air - at up to 7.5 at - at a rate of over 1.8 running meters/day. Upon partial hydraulic fracture, when for various reasons the process did not bring about a sharp decrease in the hydraulic resistance of the section, water supply to the coal seam led to an increase in steam permeability; fire linkage of the boreholes to the fire face then proceeded at a rate close to 2 m/day, with air consumption of 5,400-13,300 Nm^3 per running meter of channel under a high-pressure and later a medium-pressure air flow. Gasification of the coal seam in the channels formed by using hydraulic fracture of the seam proceeded stably. Gasification was carried out at limited air flow rates - up to 2500 Nm^3/hr - with production of gas whose weighted mean combustion heat was 913 kcal/Nm^3 over the entire period, and 1070 kcal/Nm^3 over the period when the air flow was supplied at a rate of over 1500 Nm^3/hr.

LIQUEFACTION

REFER ALSO TO CITATION(S) 35869, 35875, 36608, 36621, 36853

35885 (DOE/ER/00854—29) **Characterization of carbonaceous materials using extraction with supercritical pentane.** Fetzer, J.C.; Graham, J.A.; Arrendale, R.R.; Klee, M.S.; Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 30 May 1980. Contract AS09-76ER00854. 30p. NTIS, PC A03/MF A01.

The use of carbonaceous adsorbents is limited by irreversible adsorption of some compounds so the use of supercritical pentane as an extracting solvent was examined. Carbon black appeared to be broken down slowly, but continuously, by the penane. To see if other types of carbon behaved similarly, high purity graphite, technical grade graphites, active carbons, and charcoals were examined. The extracts were characterized by uv spectroscopy, packed column chromatography using flame ionization and flame photometric detectors, and capillary GC/MS. The extracts were characteristic for each class of carbonaceous material. The high purity graphite yielded large, polycyclic aromatic compounds; the technical grade graphites yielded alkanes and alkyl-substituted benzenes and naphthalenes; the active carbons yielded alkanes, dienes, and small amounts of alkyl-substituted benzenes; and the charcoals yielded almost entirely alkanes in small amounts.

35886 (DOE/ET/10149—T2) **H-coal fluid dynamics. Final report, August 1, 1977-December 31, 1979.** (Amoco Oil Co., Naperville, IL (USA). Research and Development Dept.). 16 Apr 1980. Contract AC05-77ET10149. 296p. NTIS, PC A13/MF A01.

This report presents the results of work aimed at understanding the hydrodynamic behavior of the H-Coal reactor. A summary of the literature search related to the fluid dynamic behavior of gas/liquid/solid systems has been presented. Design details of a cold flow unit were discussed. The process design of this cold flow model followed practices established by HRI in their process development unit. The cold fow unit has been used to conduct experiments with nitrogen, kerosene, or kerosene/coal char slurries, and HDS catalyst, which at room temperature have properties similar to those existing in the H-Coal reactor. Mineral oil, a high-viscosity liquid, was also used. The volume fractions occupied by gas/liquid slurries and catalyst particles were determined by several experimental techniques. The use of a mini-computer for data collection and calculation has greatly accelerated the analysis and reporting of data. Data on nitrogen/kerosene/HDS catalyst and coal char fines are presented in this paper. Correlations identified in the literature search were utilized to analyze the data. From this analysis it became evident that the Richardson-Zaki correlation describes the effect of slurry flow rate on catalyst expansion. Three-phase fluidization data were analyzed with two models.

35887 (DOE/ET/14800—13) **Exploratory research on solvent refined coal liquefaction. Annual technical progress report, January 1-December 31, 1979.** (Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS (USA)). Sep 1980. Contract AC01-79ET14800. 100p. NTIS, PC A05/MF A01.

This report summarizes the progress of the Exploratory Research on Solvent Refined Coal Liquefaction project by The Pittsburg and Midway Coal Mining Co.'s Merriam Laboratory during 1979. In a series of experiments with varying feed gas composition, low levels (5 to 10 mole %) of carbon monoxide had little effect on the SRC II processing of Pittsburgh Seam coal (Powhatan No. 5 Mine) while higher levels (20 to 40 mole %) resulted in a general degradation of operability and reduced oil yields. Addition of finely divided ($\sim$ 1 μm) pyrite to the reactive Powhatan coal had little effect on oil yields although the molecular weight of the distillation residue was apparently decreased. When finely divided pyrite and magnetite were added to the less reactive coals from the Loveridge and Blacksville No. 1 Mines (also Pittsburgh Seam), however, substantial increases in oil yields and product quality were obtained. In a comparison of upflow and downflow dissolver configurations with Powhatan coal in the SRC II mode, there was no difference in yields or product quality. A study characterizing specific reactors revealed a significantly higher conversion in the SRC I mode with a reactor approximating plug flow conditions compared to a completely backmixed reactor. In the SRC II mode there was only a slightly higher oil yield with the plug flow reactor.

35888 (FE—2315-52) **Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Quarterly report, January-March 1980.** Sullivan, R.F.; O'Rear, D.J. (Chevron Research Co., Richmond, CA (USA)). Mar 1980. Contract EX-76-C-01-2315. 41p. NTIS, PC A03/MF A01.

Asphaltenelike impurities in the Illinois and Wyodak H-Coal syncrudes were found to have a large effect on the performance of the hydrotreating catalyst which upgrades these syncrudes to jet or diesel fuels. When these impurities are removed by redistilling the syncrudes, the space rate of the Illinois H-Coal syncrude hydrotreater can be increased from 0.5 to 1.5 with constant product quality and catalyst performance. After hydrotreating, a small amount of 600°F+ oil in the products from the whole H-Coal syncrudes makes the products fail several jet fuel tests: gravity, gum content, end point, and occasionally freeze point. When the 600°F+ oil is removed, either by distilling the syncrude or hydrotreated

product, these specifications are met. Fuel oils can be made from the whole H-Coal syncrudes at either moderate conditions (1800 psia and 1.5 LHSV) or at severe conditions (2300 psia and 0.5 to 1.0 LHSV). At moderate conditions the hydrogen consumption is low and the aromatic product almost meets the specification for gravity and viscosity. However, this oil which contains ~ 50% aromatics may cause smoke in some burners. At severe conditions the hydrogen consumption is high but the product contains less than 5% aromatics. While all heating fuel specifications are met for this product, it would probably be used as more valuable jet or diesel fuel.

35889 (FE—2893-49) **EDS coal liquefaction process development. Phase IV. Quarterly technical progress report, January 1-March 31, 1980.** (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jul 1980. Contract AB01-77ET10069. 241p. NTIS, PC A11/MF A01.

Continuous bottoms recycle shakedown operations with Pittsburgh seam coal from the Ireland mine in West Virginia were initiated in the 50 pounds-per-day Recycle Coal Liquefaction Unit. Two combinations of pressure and solvent-to-coal-to-bottoms ratio were investigated at liquefaction conditions of 840°F, 100 minutes nominal residence time, 4 weight percent hydrogen treat rate on coal, and a 4 or greater solvent quality index (SQI). Little effect of bottoms recycle on yield distribution was observed at 1500 psig compared to coal-only operations at those conditions. At 2500 psig, marked increases were observed for C_1-C_3 gas, C_4-400°F naphtha and C_4-1000°F liquid yields as well as conversion and hydrogen consumption. Elementally balanced yields are reported for bottoms recycle operations on Illinois No. 6 (Monterey No. 1 mine). These data confirm that higher pressure bottoms recycle substantially improves conversion and liquid yield compared to once-through, coal-only operations. High pressure liquefaction experiments with Illinois (Monterey mine) coal on the Once Through Coal Liquefaction Unit (OTCLU) showed that increasing temperature from 800 to 840°F at 2000 psig increases the conversion by 7 wt % on coal. This increase is distributed among gas make, water make and C_4/1000°F liquid yield. A further increase in pressure to 2500 psig does not show any significant effect on yields. Correlations are being developed from the RCLU data base which allow the prediction of coal conversion and yield structure with bottoms recycle.

35890 (FE—3297-5) **Development of unique catalysts for hydrodenitrogenation of coal-derived liquids.** Katzer, J.R.; Stiles, A.B.; Kwart, H. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1 Feb 1980. Contract AS01-78ET03297. 46p. NTIS, PC A03/MF A01.

Experimental runs using decahydroquinoline as a reactant have been made. It would appear that hydrodenitrogenation requires an acidic site and a basic site for the β-elimination reaction to occur. Runs have also been made using sulfided and unsulfided catalysts. Previously, it was thought that the sulfur formed during sulfiding of the catalyst could block the active sites of the catalyst and inactivate it. However, there was no significant difference in nitrogen removal rate between the sulfided and unsulfided catalyst, indicating that sulfiding of these catalysts does not deactivate them. Several catalysts have been prepared and tested with the emphasis on understanding the nature of catalyst function responsible for carbon-nitrogen bond scission. The catalysts tested include catalysts with Co and Ni impregnated on silica-alumina or γ-alumina supports. However, neither one displayed adequate nitrogen removal rates. The rate of nitrogen removal was highest for the molybdenum on γ-alumina catalyst. Several catalysts were prepared with the objective of developing new hydrodenitrogenation catalysts which would selectively coordinate the nitrogen atom and remove it without hydogenating the entire ring. Catalysts prepared by coprecipitation and by impregnation were compared for their nitrogen removal rates, using decahydroquinoline as the reactant. Preliminary results indicate that the catalyst prepared by coprecipitation removed nitrogen much more quickly than the impregnation-type catalyst. From these results and using the criteria of chemical and mathematical feasibilities, a network for the hydrodenitrogenation of decahydroquinoline has been hypothesized.

35891 (LASL—80-13(MINI-REV.)) **Synfuels from coal lessons: from South Africa.** Thurston, R.S. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01.

The most significant lessons provided by these developments at SASOL are the importance of long-range planning and the need for establishing a commercialized technology base in synfuels. These are necessary to reduce our dependence on foreign energy sources and can be accomplished with suitable cooperation between government and private industry and between agencies within the government. The Fischer-Tropsch process is not the only method for producing gasoline from coal, but so far it is the only one commercially proven. Another process, which produces gasoline from methanol, has been considered for commercialization. The government of New Zealand decided in December 1979 to build a commercial-size plant using its abundant natural gas as the feedstock in a natural gas to methanol to gasoline process. Because methanol can also be produced from gasified coal, this process may be an attractive option for the production of gasoline from coal in the United States. South Africa has demonstrated that a nation can respond quickly to a deteriorating energy situation by making a long-term commitment to the establishment of an alternative energy technology. Their commitment went beyond the planning, research, and pilot-plant stages. They built a commercial-size plant to develop the appropriate producion, marketing, and environmental expertise to use the alternative technology with confidence. For the United States to be prepared to bring an alternative energy technology online quickly, it too will have to make long-term commitments by building commercial-size plants.

35892 (LBL—10000, pp 475-494) **Fossil Energy.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Research on the following topics are reported: electrode surface chemistry, deuterium analysis of coal by NMR, coal liquefaction alloys testing, oil shale retort components, and chemistry and morphology of coal liquefaction. (DLC)

35893 (ORNL/EIS—170) **Environmental compliance program handbook: Kentucky.** Huffstetler, J.; Collier, B.N.; D'Amico, A.; Gross, C.; McAfee, N.; Brown, K. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 304p. NTIS, PC A14/MF A01.

The US Department of Energy (DOE) has provided funding for studies of two coal conversion demonstration facilities that may be located in the Commonwealth of Kentucky. In addition, a large pilot plant funded by DOE has been constructed in Kentucky and is scheduled to commence operation in spring 1980. This handbook identifies those Kentucky environmental laws, administrative rules and regulations, and permitting procedures that could affect the siting, construction, or operation of such facilities. Areas of primary concern include air quality, water quality, solid waste disposal, and hazardous waste disposal. All entries are part of a computerized data base built and maintained for DOE at Oak Ridge National Laboratory.

35894 (ORNL/EIS—173) **Environmental Compliance Program Handbook: West Virginia.** Huffstetler, J.; Collier, B.N.; D'Amico, A.; Gross, C.; McAfee, N.; Brown, K. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 314p. NTIS, PC A14/MF A01.

The US Department of Energy (DOE) has provided funding for a study of a coal conversion demonstration facility to be located in the state of West Virginia. The facility will demonstrate the technical and economic feasibility of the Liquid Product Solvent Refined Coal (SRC-II) Process. This handbook identifies those West Virginia environmental laws, administrative rules and regulations, and permitting procedures that could affect the siting, construction, or operation of this facility. Areas of primary concern include air quality, water quality, solid waste disposal, and hazardous waste disposal. All entries are part of a computerized data base built and maintained for DOE at Oak Ridge National Laboratory.

35895 **Hydrogen-donor coal liquefaction process.** Mitchell, W.; Wilson, E. (to Exxon Research and Engineering Co). US Patent 4,210,518. 1 Jul 1980. Filed date 12 Oct 1978. vpp.

a description is given of a hydrogen-donor liquefaction process for converting coal or similar carbonaceous solids into lower molecular weight liquid hydrocarbons which comprises: (A) contacting said carbonaceous solids with a hydrogendonor solvent and molecular hydrogen at a temperature in the range between about 775°F and about 950°F in a liquefaction zone operated such that the temperature remains substantially constand throughout said zone and wherein said carbonaceous solids are converted into lower molecular weight liquid hydrocarbons to form a liquefaction effluent, said hydrogen-donor solvent having a donatable hydrogen concentration higher than the thermodynamic equilibrium concentration at the temperature in said liquefaction zone when said solvent enters said zone; (B) maintaining a higher concentration of catalytic material that is active in promoting the hydrogenation of aromatics to form hydroaromatics in said liquefaction zone near said outlet of said zone than near said inlet of said zone ; and (C) recovering liquid hydrocarbonaceous products from said liquefaction effluent.

35896 **Process for removal of mineral particulates from coal-derived liquids.** McDowell, W.J. (to Dept. of Energy). US Patent 4,191,628. 4 Mar 1980. Filed date 12 Oct 1978. 10p.

PAT-APPL-950,875.

Suspended mineral solids are separated from a coal-derived liquid containing the solids by a process comprising the steps of contacting the coal-derived liquid containing the solids with a molten additive having a melting point of 100 to 500°C, maintaining the contact for a period of time sufficient to permit the mineral matter to agglomerate, and recovering the coal-derived liquid prod-

uct having reduced mineral solids content. The molten additive must be present in an amount sufficient to increase the particle size of the minerals (up to as much as 50 wt % of the coal-derived liquid) and comprises a material or mixture of material selected from the group of alkali metal hydroxides and inorganic salts having antimony, tin, lithium, sodium, potassium, magnesium, calcium, beryllium, aluminum, zinc, molybdenum, cobalt, nickel, ruthenium, rhodium, or iron cations and chloride, iodide, bromide, sulfate, phosphate, borate, carbonate, sulfite, or silicate anions. The process can be carried out with less than 5 wt % additive and in the absence of H_2 pressure. (BLM)

PYROLYSIS AND CRACKING

35897 Method and apparatus for retorting a substance containing organic matter. Schulman, B. (to Tosco Corp). US Patent 4,210,491. 1 Jul 1980. Filed date 16 Oct 1978. vpp.

A description is given of an apparatus for converting a substance containing organic matter into hydrocarbon vapors and solids residue comprising: (A) a fluidized bed housing having an upstream end and a downstream end; (B) a substantially cylindrical retort, extending through and stationary relative to said fluidized bed housing and having an upstream end and a downstream end, each end being outside of said housing, the longitudinal axis of said retort being substantially parallel to a horizontal plane; (C) feeding means for feeding the substance containing organic matter into said retort, said feeding means communicating with the upstream portion of said retort; (D) means located within said retort for moving the substance containing organic matter from the upstream portion of said retort to the downstream portion thereof; (E) solids residue removing means for removing solids residue from said retort, said solids residue removing means communicating with the downstream portion of said retort; (F) solids residue introducing means for introducing said solids residue removed from said retort into said fluidized bed housing to employ said solids residue as particles of a fluidized bed, one end of said introducing means communicating with said solids residue removing means and the other end therof communicating with the upper upstream portion of said fluidized bed housing; (G) solids residue extracting means for extracting solids residue from said fluidized bed housing and communicating with the lower downstream portion fluidized bed housing; (H) fluidizing menas for maintaining within said fluidized bed housing a fluidized bed of heated particles of solids residue with which to heat said retort; (I) heating means for heating the particles; (J) hydrocarbon vapors removing means.

35898 Process for the pyrolysis of coal in dilute-and dense-phase fluidized beds . Roberts, S. (to Shell Oil Co). US Patent 4,210,492. 1 Jul 1980. Filed date 14 Mar 1977. vpp.

A description is given of a process for the pyrolysis of coal comprising, (A) countercurrently contacting coal subdivided to a particle size fluidizable in gas in the form of a relatively cool, upwardly mving fluidized mass in a first vertically-oriented preheating zone with an inert relatively hot first particulate heat carrier thereby transferring sensible heat from the heat carrier to the subdivided coal and heating said coal to an elevated temperature not above the boiling point of water, said coal being fluidized in gas in a manner to create a dilute-phase fluidized mass in said first preheating zone and said particulate heat carrier being introduced in the upper portion of the preheating zone and having a particle size and density such that it falls through the dilute-phase fluidized mass at a substantially uniform rate and collects in the lower portion of the vertical preheating zone as a relatively cool first particulate heat carrier; (B) recovering the bulk of said subdivided coal at elevated temperature in the upper portion of said preheating zone and passing said recovered coal to a second preheating zone; (C) recovering said relatively cool first particulate heat carrier in the lower portion of said preheating zone, and passing said recovered heat carrier to a heat recovery zone; (D) introducing said subdivided coal at elevated temperature into a second verticaly-oriented preheat zone as a dense phase, flidized mass in gas, and countercurrently contacting said fluidized mass with a second inert particulate heat carrier heated to a temperature above the boiling point of water to transfer sensible heat from the heat carrier to the coal and remove any water in the coal, said second particulate heat carrier being introduced in the upper portion of the second preheat zone.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 36047

PROPERTIES

REFER ALSO TO CITATION(S) 36971

35899 (DOE/ET/10816—T1(Vol.1), pp 3-55) **Characterization of coal for open-cycle MHD power generation system.** Diebold, F. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Research to establish a set of coherent analytical procedures for the rapid, accurate, and precise analysis of coal has involved the investigation of the application of a number of instrumental techniques. The coal properties considered are Btu, proximate and ultimate values, major metal concentrations, minor metal concentrations, and minor non-metal concentrations. The emission spectrographic procedure utilizing the acid-bomb coal solutions with the ARL direct-reading emission spectrograph has indicated it to be relatively rapid and accurate for the elements currently programmed on the recording console, namely, Na, Ca, Mg, Si, Al, Ti, Cu, B, Mn, V, Cr, Ni, Pb, Ba, Sr, and Ga. An intensive evaluation of available inductively coupled plasma-source emission spectrometers has resulted in the selection of the ISA instrument, which will analyze a relatively large number of coals for a comparatively large number of elements in a short time. The atomic absorption spectrometer cold vapor techniques for Mg, As, Se, Sb, and Sn have been established and shown to be adaptable to the acid-bomb coal solutions. The procedure for directly determining the O_2 content in coal has been established using a PE 240 automated C-H-N-O analyzer equipped with an O-kit. The x-ray fluorescence procedure for sulfur in the acid-bomb solutions has been investigated; preliminary results indicate it to be relatively free of interferents compared to the use of solid coal samples. The investigation of the sample preparation procedures has indicated that the combustion and the low-temperature, low-pressure acid digestion of the coal sample are not preferable to the acid-digestion procedure with respect to digestion time and potential loss of volatiles.

35900 (DOE/ET/10816—T1(Vol.1), pp 176-193) **Characterization of volatile matter in coal.** Beuerman, D. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

The loss of Btu value during the drying process has been shown to be due to the loss of organic matter during the heating cycle. Tests have shown that this heat loss is not due to surface oxidation of the coal. Techniques for the separation and identification of organic compounds lost from the coal during heating have been improved. New compound identifications are reported. In an effort to close the material balance on the amount of volatile organics lost, bench tests were made in which highly volatile material was collected in a liquid nitrogen trap. A considerable amount of highly volatile matter apparently is lost from the coal during drying. This loss could include oxygen (absorbed) and low-chain alkanes (methane, ethane, etc.). This material as yet has not been characterized.

35901 (DOE/PC/30013—1) **Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, February-April 1980.** Davis, A.; Suhr, N.H.; Spackman, W.; Painter, P.C.; Walker, P.L.; Given, P.H. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Jun 1980. Contract AC22-80PC30013. 55p. NTIS, PC A04/MF A01.

The basic objective of this program is to invetigate systematic relationships between the properties of US coals and macerals. Thirty-five samples from the Lower Kittanning seam have been collected to study the vertical and lateral variability of petrographic, chemical, mineralogical and plastic characteristics within a single coal seam. The ratio of aromatic to aliphatic C-H groups as measured by the integrated absorption or peak areas shows a linear relationship with coal rank (reflectance). Uptake of CO_2 at 25°C on -20 mesh sizes of selected coals (PSOC-1166, 1171, 1197, and 1201) has been measured. From Dubinin-Polanyi plots, micropore surface areas and micropore volumes were obtained. Displacement of mercury was used to estimate particle densities for -20 mesh and -100 mesh sizes of coals and vitrinite concentrates. Some uncertainty in this measurement is introduced because of the difficulty of knowing at what pressure filling of voids between particles with mercury is complete. A new helium density apparatus has been constructed which promises to speed up measurements. Two coals from China were found to have very unusual characteristics. The extremely high liptinite (cutinite) content of one would account for its anamolous chemical composition and liquefaction behavior. Several organic and inorganic components of liquefaction residues can be recognized under the microscope. The proportions of these components in residues from experiments performed by PETC appear to be related to process conditions. Major, minor element and mineralogical analyses are reported for up to 21 coals.

35902 (EPRI-CS—989(Vol.1)) **Nuclear assay of coal. Volume 1. Coal composition by prompt neutron activation analysis: basic experiments. Final report.** Reynolds, G.; Bozorgmanesh, H.; Elias, E.; Gozani, T.; Maung, T.; Orphan, V. (Science Applications, Inc., Palo Alto, CA (USA)). Apr 1980. 80p. NTIS, PC A05/MF A01.

Using californium-252 as a source of exciting neutrons, prompt gamma photons emitted by elemental nuclei in the coal have been measured using several detectors, including sodium-iodide and germanium-lithium. Several coal types, including bituminous, subbituminous lignite and anthracite were crushed to various top sizes and analyzed carefully by traditional ASTM wet chemistry techniques at two or three different laboratories. The elements (sulfur, hydrogen, carbon, aluminum, silicon, iron, calcium, sodium, nitrogen, and chlorine) were determined by prompt neutron activations and the quantities compared with those of the wet chemical analyses.

35903 (EPRI-CS—989(Vol.3)) **Nuclear assay of coal. Volume 3: determination of total hydrogen content of coal by nuclear techniques. Final report.** Gozani, T.; Elias, E.; Bozorgmanesh, H. (Science Applications, Inc., Palo Alto, CA (USA)). Apr 1980. 26p. NTIS, PC A03/MF A01.

The hydrogen content of coal is of primary concern to both designers and operators of coal-based utility plants. This report reviews possible nuclear techniques for determining the total hydrogen content of coal given the wide variations in composition and density found in practical measurement. This study was based on theoretical neutron transport calculations and laboratory experiments. This study has shown that hydrogen is most accurately determined by measuring the leakage of epithermal neutrons from a slab sample 30 cm thick. Using this method, hydrogen density was measured with an average absolute error of 6.2×10^{-4} g/cm^3. For example, for 6 percent weight hydrogen and an average bulk density of 0.7 g/cm^3, the average relative error is less than 1.5 percent. This result was achieved with no prior knowledge regarding the type, composition, and bulk density of the sample. Higher accuracy is achievable if the variations in coal type are bounded. Although this study was directed towards coal measurement, its main conclusions can in principle be applied to other solid materials of variable bulk density and elemental composition.

35904 (EPRI-CS—989(Vol.4)) **Nuclear assay of coal. Volume 4: moisture determination in coal - survey of electromagnetic techniques. Final report.** Brown, D.R.;Gozani, T.; Elias, E.; Bozorgmanesh, H.; Bevan, R.; Luckie, P. (Science Applications, Inc., Palo Alto, CA (USA); Kennedy Van Saun Corp., Danville, PA (USA)). Apr 1980. 60p. NTIS, PC A04/MF A01.

This survey consists of two basic parts. The first consists of a survey of various non-nuclear moisture determination techniques. Three techniques are identified as promising for eventual on-line application with coal; these are capacitance, microwave attenuation, and nuclear magnetic resonance (NMR) techniques. The second part is devoted to an in-depth analysis of these three techniques and the current extent to which they have been applied to coal. With a given coal type, accuracies of +- 1% absolute in moisture content are achievable with all three techniques. The accuracy of the two electromagnetic techniques has been demonstrated in the laboratory and on-line in coal burning plants, whereas only small samples have been analyzed with NMR. The current shortcoming of the simple electromagnetic techniques is the sensitivity of calibrations to physical parameters and coal type. NMR is currently limited to small samples sizes and non-rugged design. These findings are summarized and a list of manufacturers of moisture analyzers is given in the Appendix.

35905 (EPRI-CS—989(Vol.6)) **Nuclear assay of coal. Volume 6. Mass flow devices for coal handling. Final report.** Gozani, T.; Elias, E.; Bevan, R. (Science Applications, Inc., Palo Alto, CA (USA); Kennedy Van Saun Corp., Danville, PA (USA)). Apr 1980. 43p. NTIS, PC A03/MF A01.

The mass of coal entering the boiler per unit time is an essential parameter for determining the total rate of heat input. The mass flow rate of coal on a conveyor belt is generally determined as a product of the instantaneous mass of material on a short section of the belt and the belt velocity. Belt loading could be measured by conventional transducers incorporating mechanical or electromechanical weighers or by gamma-ray attenuation gauge. This report reviews the state of the art in mass flow devices for coal handling. The various methods are compared and commented upon. Special design issues are discussed relative to incorporating a mass flow measuring device in a Continuous On-Line Nuclear Analysis of Coal (CONAC) system.

35906 (EPRI-CS—989(Vol.7)) **Nuclear assay of coal. Volume 7. Coal rheology and its impact on nuclear assay. Final report.** Gozani, T.; Hogg, R.; Luckie, P. (Science Applications, Inc., Palo Alto, CA (USA); Kennedy Van Saun Corp., Danville, PA (USA)). Apr 1980. 34p. NTIS, PC A03/MF A01.

A number of possible techniques for introducing coal to a continuous on-line nuclear analysis of coal (CONAC) system have been evaluated, including flow methods and nonflow methods. A modified flat-belt feeder system was recommended. The success of such a coal-presentation technique would rely on proper entry to the feed hopper, shape of the withdrawal opening from the feed hopper, and a slow belt speed to minimize demixing.

35907 **Reading the composition of coal.** *EPRI J.*: **5**: No. 6, 7-11(Jul 1980).

A new apparatus, (CONAC), is being developed to handle a large quantity (up to 50 tons per hour) of coal at a high speed and give an accurate and continuous nuclear analysis without affecting the coal or preventing retesting. CONAC will increase the efficiency of coal resources by identifying the coal which meets boiler-performance and emission-standard specifications. Coal varies in heating value, moisture content, sulfur and nitrogen percentages, and ash content, all of which affect the cost-effectiveness of power plant operation. Relying on neutron activation of coal by a radioactive californium, the CONAC apparatus provides more-reliable information than conventional analytical tests. (DCK)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 35864, 36618, 37179

35908 (BNL—51223) **Regenerative process for desulfurization of high temperature combustion and fuel gases. Progress report No. 14, October 1-December 31, 1979.** Albanese, A.S.; Sethi, D.S. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01.

The characteristics of Portland Type III cement (PC III) as a potential sorbent for use in a regenerative process for desulfurization of coal in fluidized-bed combustion were examined. The sulfation rates for PC III + 5% amorphous SiO_2 at temperatures between 860 and 1100°C and at 1 atm were studied thermogravimetrically, using a simulated combustion gas mixture containing 0.25% SO_2. The sulfation rates were found to be independent of temperature between 950 and 1050°C. The isothermal regeneration with a mixture consisting of 5% CO, 15% CO_2 and the balance N_2, in this 100°C temperature interval approached an equilibrium value of over 90% within thirty minutes. Sulfation/regeneration efficiency did not decrease with cycling and was unaffected by additives introduced to increase the porosity and/or conversion of free CaO in PC III to silicates which are known to be more regenerative than $CaSO_4$. Pressurized TGA experiments within the optimum sulfation temperature range were conducted at 5 and 10 atm to establish the viability of this sorbent for pressurized fluidized-bed combustion use. Within the experimental accuracy, no pressure dependence of sulfation rate was observed. Our experiments indicate that the attrition resistance of PC III is significantly better than natural limestones.

35909 (DOE/ET/14211—T1) **Study of the properties of mine waste in the midwestern coal fields. Phase I report.** (Dames and Moore, Park Ridge, IL (USA)). 4 Jul 1980. Contract AC01-79ET14211. 237p. NTIS, PC A11/MF A01.

In an effort to assist the coal industry in complying with the applicable regulations, to design safe and environmentally acceptable disposal systems, and to encourage secondary use of coal mine waste, the US Department of Energy has initiated research programs to develop coal mine waste disposal and use technology. This study of the properties of mine wastes in the Midwestern coal fields has been limited to the waste materials obtained from underground coal mines and preparation plants attached to both underground and surface mines. The program has been divided into two phases. In Phase I, the 20 most important properties relevant to safe disposal, reclamation, underground disposal, and secondary uses have been identified. An inventory of the significant waste disposal sites in the Midwestern coal fields has been prepared. The site locations have been plotted on USGS maps. Estimates of coal production and coal mine waste production during the next 2 decades have been prepared and are presented in this report. Also, all available information obtained from a search of existing literature on physical and chemical properties, including analysis results of the general runoff from the refuse disposal areas, has been collected and is presented. In order to fill the gaps in information, 20 sites have been identified for drilling and sampling to determine the various physical and chemical properties. They have been selected on the basis of the distribution and quantity of waste at the existing locations (both abandoned and active), the future trends in production and likely locations of waste disposal areas, their geographical and geological distribution, and ease of accessibility for drilling and sampling.

35910 **Aluminium from coal: US scientists like the odds.** *Ash at Work;* **8**: No. 5, 4(1976).

A method for manufacturing aluminum from pfa is described.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 35869, 35881, 35893, 35894, 35937, 37147, 37148, 37235, 37237

35911 Solid waste disposal, embankments, and monitoring control. Corwine, J.W.; Stewart, B.M. (Bureau of Mines, Spokane, WA). pp 121-128 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The Federal Bureau of Mines has been conducting health and safety research in coal mine waste disposal since 1972. At that time, five major health and safety research objectives were established to improve waste disposal techniques and thereby reduce or eliminate hazards associated with waste disposal. The research objectives include the following: (1) improve disposal methods of coal mine waste material, (2) determine chemical and physical properties of coal mine waste materials, (3) develop structural analysis technology for design and evaluation of refuse embankments, (4) develop dynamic design parameters of coal waste embankments, and (5) develop practical hazard rating techniques for regulatory and testing purposes. The Bureau has established program plans designed to accomplish these objectives. The research program has remained flexible; as new waste disposal problems became apparent, the Bureau's research effort increased. Presently funded work includes research in physical properties of coarse and fine coal waste mixtures, monitoring and instrumentation, geometric design of embankments, seepage control, slope stability, and waste disposal alternatives including sludge dewatering.

RESERVES AND EXPLORATION

35912 Density determinations from borehole gravity data from a shallow lignite zone within the Denver formation near Watkins, Colorado. Robbins, S.L. (Geological Survey, Denver, CO). pp 20p, Paper JJ of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Two 50- to 55-meter-deep test holes near Watkins, Colorado, penetrate through an 8-meter-thick lignite zone within the upper Cretaceous and Paleocene Denver Formation. These test holes were surveyed using a borehole gravity meter (BHGM), and the principal facts along with a summary of data-interpretation relationships and data accuracies are presented. Conclusions derived from the BHGM data and comparisons of these data with gamma-ray and gamma-gamma logs are as follows: (1) the lignite densities are in the 1.3- to 1.4g/cm^3 range, with differences between the BHGM density values and gamma-gamma density values for these zones ranging from 0.2 to 0.3 g/cm^3 higher for the gamma-gamma values; (2) these differences are probably caused by both mud invasion into parts of the lignite seams and a (Z/A) ratio in the gamma-gamma log reduction that is too low; (3) porosities for the clastic sediments are between 27 and 42% (4) water saturation of these sediments above the water table at the time of the survey was about 70%; and (5) since the gamma-ray logs proved to be a poor method in this area for ash content determination and the density values from the gamma-gamma logs were too high, care must be used when interpreting logs from radiation sensitive tools in wells containing organic material.

MINING

REFER ALSO TO CITATION(S) 35911, 35934, 35935, 35936

35913 (DOE/ET/14270—T1) **Feasibility of a continuous surface mining machine using impact breakers. First quarterly report, October 1-December 31, 1979.** Fisk, A.T. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Jan 1980. Contract AC01-79ET14270. 37p. NTIS, PC A03/MF A01.

This is the first quarterly report on the efforts to evaluate the feasibility of excavating coal and overburden from surface mines using impact breakers. The initial stages of the project are devoted to a literature search, equipment selection, test site selection, and conceptual test system design. Hence, this report details the progress made in these areas; the next quarter will see the finalization of Phase I. Included as appendices to this report are FMA internal reports on the individual mines visited. These reports are the basis of the test site selection, and have been censored here to remove data the mine operators deemed as confidential.

35914 (DOE/ET/14270—T2) **Feasibility of a continuous surface mining machine using impact breakers. Phase I report, 1 October 1979-31 March 1980.** Fisk, A.T.; Simpson, R.J. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Apr 1980. Contract AC01-79ET14270. 84p. NTIS, PC A05/MF A01.

This is the first phase report of the efforts to evaluate the feasibility of excavating coal and overburden from surface mines using impact breakers. Phase I is divided into four task groups. Those tasks are as follows: Selection of Field Sites for Parametric, Selection of Impact Hammers for Field, Design Test System, and Prepare Parametric Test Plan. A detailed description and accounting of each task is given in the body of this report. Included as appendices are the FMA internal reports on the individual mines visited. These reports are the basis of test site selection. The basic finding of this phase are that industry interest in the concept of impact mining tends toward the removal of multiple thin seams of coal and parting rather than deep coal or overburden and, while the intent of this contract is to explore the feasibility of impactors in a vertical array for use in a terraced mine plan, future design of a continuous mining machine should take industry acceptance into account.

35915 Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978). 222p. (CONF-7711145—).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The Third Institute on Coal Mine Health and Safety was held Nov 30, Dec 1-2, 1977, at the Colorado School of Mines, Golden, Colorado. It was cosponsored by the Mine Enforcement and Safety Administration, the US Bureau of Mines and the Colorado School of Mines. The papers dealt with miner training, reduction of hazards in roof bolting, enbankment stability, blasting safety, improved lighting systems, degassing, etc. Seventeen papers have been entered individually into EDB and ERA. (LTN)

35916 Update on the education and training program of West Virginia for improved mine health and safety. Currie, C.L. (Wheeling Coll., WV). pp 59-72 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

Since 1974 there has been a rather unique collaborative effort in West Virginia to improve training for safety in the coal industry. The state legislature, coal miners, the UMWA, coal operators, the State Department of Mines, a newly established Board of Miner Training, Education and Certification, the State Board of Education, and outside consultants have all worked together toward this end. MESA has been a most important financial supporter of this activity. This paper describes our pre-employment training program and reports on current activities concerning a Mine Foreman Certification Program and an Electrician Certification Program.

35917 BCOA/NCA training programs. Wampler, J.A. (Bituminous Coal Operators' Association, Washington, DC). pp 73-77 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

Our approach in designing a training program is this: We present short bursts of information, realistically and dramatically presented, followed by the mental and physical exercise of the presented material and then more short bursts of the audiovisual material and the attendant exercises. We are taking advantage of the fact that most trainees today are almost totally visually oriented. The average trainee cannot remember when there wasn't television. And he's a sophisticated viewer - quickly bored by less than professional quality, but definitely trainable by strong, task-related, audiovisual programs. All programs produced are designed to be presented by a person with technical knowledge, but who is not necessarily a professional instructor. With a system designed in this manner, supervisors become the logical instructors.

35918 Safety education: its effective implementation. Morrell, J.F. (North American Coal Co., Powhatan Point, OH). pp 80-83 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The closer the training is to the environment in which the learning process is to be used, the more effective will be the training. There are two major points regarding the implementation of any effective program. The first concerns obtaining involvement, participation, commitment and responsible behavior, and the second concerns maintaining that behavior. Often when we communicate, we concern ourselves only with the surface reactions of those to whom we are communicating. Somewhere along the line, while we are constructing our message, we should consider the results we want to obtain. We consider them in the form of some behavior that the recipient will demonstrate to us. This particular type of behavior must be clearly defined before communications or implementation begins. However, many times, even after the behavior has been defined, and the necessary directions and instructions have been given, we still have no results. Why are there no results, and why does the program fail on implementation? Let's list some of the

blocks that stand in the way of successful implementation: lack of experience on the part of the recipient or implementor, lack of ability on the part of the recipient or implementor, lack of incentive on the part of those responding, no appropriate consequences, negative attitude toward the company, or negative attitude toward authority. All of these factors should be considered before initiation or implementation of the program. They will help us get to know more about the people who will be reacting to the program. For example, these factors can tell us if the person is experienced or inexperienced, what their sociological attitudes are toward authority, work, and so forth. The more we know about the recipients, the better we can predict their response to the program.

35919 Blasting requirements of the new Surface Mining regulations. Foster, G.A. (Vibra-Tech Engineers, Inc., Rockville, MD). pp 84-100 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

This paper discusses the regulations as they relate to blasting as required by the Surface Mining Control and Reclamation Act of 1977. The proposed implementation provisions were published in the Federal Register on September 7, 1977 and public hearings held on them at four locations on September 20, 21, and 22, 1977. These proposed regulations are to apply to all coal mining operations regulated by the States until a State has an approved regulatory program or a Federal regulatory program is implemented in that State. After the public hearings in September it was believed that the final regulations would be published early in November 1977 but, due to the considerable input from the general public, publication is not due to take place until December 2, 1977. Since this paper is to be given on December 1, 1977, it is only with the cooperation of the Surface Mining Task Force who allowed us to see the regulations prior to publication that this paper can be given at all. We were not able to see the preamble to the regulations in which justification for the changes made since the public hearing is detailed and therefore our comments on the changes are derived from our own experience alone. It is our intent not to go through the regulations point by point but to discuss those provisions which will affect blasting directly. To our knowledge these are the first Federal Regulations which regulate directly the ground vibration and air blast effects from blasting and will inevitably affect future regulations for other explosives-using industries, such as quarrying and construction.

35920 Mandatory training of surface coal miners. Schlick, D.P.; Thirumalai, K. (Mining Enforcement and Safety Administration, Arlington, VA). pp 104-120 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

Surface mine accident and injury statistics point out the importance of health and safety training of surface miners. Over 30 percent of the miner population in the United States are either new entrants or are relocated and untrained. Over 35 percent of the fatal injuries and over 20 percent of the disabling injuries in surface coal mine occupations were experienced by miners with less than one year's job experience. Estimates also indicate that about 20,000 surface coal miners require health and safety training each year. The Federal Mine Safety and Health Amendments Act of 1977 requires the Secretary to promulgate mandatory training standards for safety and health training of miners and mine construction workers within 180 days of the effective date of P.L. 95-164 (March 9, 1978). MESA is now preparing the standards and guidelines for surface miner training programs. Mandatory surface miner training has been practiced in the Federal Republic of Germany for over a decade. It is apparent that surface coal miners in Germany have extensive training requirements.

35921 New Federal Mine Safety and Health Amendments Act of 1977 as it affects mine roof bolting. Payne, W.J. (VERMAX, Latrobe, PA). pp 129-139 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO: Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

Problems with roof bolts are discussed: material, installation, load measurement, testing and with the regulations. Producers can deliver mine roof bolts that have been made of the correct, safe material for a price. However, new marketing techniques are being offered that will permit local production - even on-site production of load-indicating mine roof bolts. These new bolts of correct specified material will be capable of indicating direct tension loads and can be made to any length needed. Each bolt is 100% machine tested for reliability of load indication and strength twice during its manufacture. Visual check features are incorporated that show the bolter operator if the indicator has gone bad as a result of damage during transit. Actual bolt load is shown during use as a simple, easily recognized color that keeps on doing its job for the life of the bolt: YELLOW for loose, GREEN for ok, BLUE for overload. Roof falls are going to be less dangerous if the loads on all the bolts are known all the time. Making bolt loads visible to everyone increases the chances of detecting safety hazards in time to correct it and maintain production safely. Bolt load checks can be accomplished without any contact other than eye contact. For metal mines, this avoids hazardous torque checks on ladders or costly time consuming use of portable platforms. A comparison of costs to install bolts using current regulations that depend upon (unreliable) torque and upgrading to demand the use of known materials show that this new indicator bolt can be incorporated without causing the mine operator a competitive cost disadvantage.

35922 Westmoreland Coal Company's approach to mine illumination. Slone, R.E. (Westmoreland Coal Co., Big Stone Gap, VA). pp 140-147 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The task of achieving compliance with the underground illumination regulations is a very complex and difficult problem for any coal operator. This task is further complicated by the many different types of machines in use and the varying thicknesses of coal seams mined. At Westmoreland we have over 100 working sections on which illumination will be required, and our coal seams range from 30 inches to 18 feet with most seams averaging 4 to 6 feet thick. This represents a considerable amount of capital to meet compliance. Because of this investment, an overall plan of design and installation was required to insure that safe maintainable lighting systems would be installed on our equipment. It is readily evident to any person with practical knowledge of modern-day coal mining that the task of providing the required levels of illumination is not an easy one. Retrofitting many of the existing machines with permissible lighting will require custom installations. Special illumination systems will be required for certain types of mining. It is a physical impossibility to have all Westmoreland's machines on all 100 working sections equipped with lighting systems by the required date of April 1, 1978, but we feel we will be able to get all of the lighting systems designed and approved within the required time. The task of achieving these goals requires a concerted effort, but utilization of our illumination laboratory, we feel, gives us a better chance of meeting compliance.

35923 Coal degasification (methane collection). Laird, W. (Gates Engineering Co., Pittsburg, PA). pp 148-159 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The US Bureau of Mines program on coal seam degasification with recovery of the methane is described, with emphasis on safety during mining, directional drilling, methane collection and compression and cost/benefit analysis. (LTN)

35924 Mining company's safety responsibilities on contract construction work at a mine site. Craft, W.M. (Mining Enforcement and Safety Administration, Madisonville, KY). pp 184-188 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The subject of how health and safety should properly be regulated during construction is a matter of particular concern. The primary concern of industry is that existing regulations do not adequately meet the needs of employees of contract construction companies, and further, that the demands of existing regulations and policies, which have been designed for permanent coal mining operations, cannot properly be met in a construction situation. Most prospective mine operators require in their contracts with construction companies that all federal and state health and safety laws be complied with; therefore, the contractual and legal responsibility for such compliance is assumed by the construction company. MESA's policy concerning contractors on mine property has varied at different times since the effective date of the Federal Coal Mine Health and Safety Act of 1969. In the Federal Mine Health and Safety Act of 1977, PL 91-173, as amended by PL 95-164, Section 3(D) of the 1969 Act, the definition of an operator as any owner, lessee, or other person who operates, controls, or supervises a coal mine is amended by adding or any independent contractor performing services or construction at such mine. This would put the contractor on mine property in the position established in the case of The Affinity Mining Co., making the contractor responsible for violations occurring in an area where the contractor had control over the situation. An operator, whether a contractor or the operator of a coal mine, is required to submit the listed information and plans. (LTN)

35925 Recommendations for reducing roof bolting hazards. Adkins, J. (Bendix Corp., Englewood, CO). pp 189-210 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

This study began by reviewing pertinent literature and related studies. The research team then collected, normalized, and analyzed data on all roof-bolter-related accidents for 1975. From these analyses the most hazardous activities in which the operator engages were identified. Nine mines were selected for underground observation of the bolting operation to identify specific hazardous conditions and/or behavior associated with each activity. The hazards observed were divided into environmental, equipment, and behavior categories, and a measure of the relative frequency of observation of each item was worked out. For each item that proved to be a significant hazard, one or more possible corrective measures were developed. When these corrective measures involved equipment design changes they were discussed with the five major manufacturers of roof bolting equipment. The recommendations have been broken down first between machine design issues and training and supervision issues. The machine design category is further subdivided into recommendations directed primarily toward the Bureau of Mines research function, toward the industry, i.e., coal operators and equipment manufacturers and toward MESA's standards setting and enforcement function. Since the training and supervision recommendations are of a more general multifaceted nature, they could not properly be directed at any single entity.

35926 Recent progress of the CSM research project on the control of respirable coal dust. Brown, J.T. Jr.; Schowengerdt, F.D. (Colorado School of Mines, Golden). pp 211-213 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

During the past three years we have been engaged in a project to study the application of a new process to the control of respirable coal dust: condensational conditioning. Condensational conditioning is a process through which the effective size of the respirable particulate is increased by growing a water droplet on it and thereby making it much simpler to remove from the environment. The reasoning behind our approach is as follows: (1) either the existing control technology needs to be significantly improved to be able to handle the very small sub-micron respirable particulates, or, (2) the physical characteristics of the particulates must be modified to make them more amenable to collection by present methods. We have chosen the latter alternative because of its engineering simplicity and potential economic advantage. Measurements confirmed our expectations that water droplets could be effectively nucleated by respirable size coal dust. In fact, the nucleation efficiency was found to lie in the range from 99.9 to 100%. The droplet growth measurements on the coal dust also indicates that by proper scaling of the process, droplet sizes of the order of 10 microns would be obtained in a fraction of a second. Once the dust has been converted to a 10 micron particle it may be regarded as controlled since both water sprays and inertial collectors operate with reasonable efficiency at this size.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 35865, 35900, 36853

35927 Method and apparatus for coal separation using fluorinated hydrocarbons. Smith, C.D.; Keller, D.V. Jr. (to Otisca Industries, Ltd.). US Patent 4,178,231. 11 Dec 1979. Filed date 31 Jul 1978. 52p.

Coal is separated in a gravity separator using a fluorinated hydrocarbon parting liquid. The cleaned coal is burned and the ash mixed with recovered parting liquid and returned to the gravity separator. Additives may be dispersed in the parting liquid to alter the physical and/or chemical characteristics of the products. The additive may be a dustproofing or a waterproofing agent.

35928 (DOE/ET/10816—T1(Vol.1), pp 149-175) **Preparation of coals for utilization in direct coal-fired MHD generation.** Rhodes, B. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

This contract period saw the completion of the work that characterized the fluidization behavior of Rosebud coal in a six-inch column operated at ambient temperature. The organic volatile study was transferred to the Characterization of Volatile Matter in Cial task on May 16, 1978. However, work continues through close coordination between the two tasks on the organic volatile loss area. This study also includes the effect that drying has on Btu values. Work continues on continuous and batch studies of coal drying in the six-inch stainless steel fluid bed dryer. These studies will be supplemented by the completion of a one square foot fluid bed unit (a scale-up of five times the bed area of the six-inch column) during the next three months and the operation of this unit to complete the study of fluid bed drying of Rosebud coal.

35929 (FE—2286-56) **Preparation of a Coal Conversion Systems Technical Data Book. Project 61003 quarterly report, August 1-October 31, 1979.** (Institute of Gas Technology, Chicago, IL (USA)). Sep 1980. Contract AC01-76ET10255. 397p. NTIS, PC A17/MF A01.

This quarterly report consists of a report on coal storage, handling, and preparation, prepared by Resource Engineering Corporation, Lexington, Massachusetts, for the Coal Conversion Systems Technical Data Book. The report was prepared in the Data Book format and is reproduced here with minor editorial corrections.

35930 (MTCH-PR—9-79) **Transport.** (Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Extraction). 1979. 90p. NTIS, PC A05/MF A01.

A list of research and development projects in surface and underground mine haulage is given with the following format: agency name (initials), agency project No., agency's project title, synopsis (objective, proposed method, and progress), project leader, associated organizations, funding date of start and expected or actual finish date. (LTN)

35931 Method and apparatus for drying a moisture-containing particulate material. Weber, C. (to Hydrocarbon Research Inc). US Patent 4,209,911. 1 Jul 1980. Filed date 22 Sep 1978. vpp.

An apparatus is described for drying moisture-containing particulates comprising; a cylindrical vessel with two closed ends and having a vapor outlet near the top end thereof, a liquid outlet near the bottom end thereof, and an inlet for a particulate material, an inlet for a hot hydrocarbon liquid having a carbon liquid, all of the inlets being intermediate the vapor outlet and the liquid outlet, and a plurality of agitator means mounted on a cylindrical shaft which is connected to a rotary driving means, one of the agitator means being mounted in the top portion of the vessel and above the particulate feed.

35932 Solid fuel use in small furnaces. Yan, T. (to Mobil Corp). US Patent 4,210,423. 1 Jul 1980. Filed date 6 Apr 1979. vpp.

A description is given of a method for producing a solid fuel for small furnaces in powder form or in briquette form which has: (A) a uniform heat content of approximately 12,000-14,000 Btu per pound, (B) a sulfur content that is balanced with a scavenger for SO2 gas to enable stack gases from said small furnaces to meet EPA emission standards for SO2, (C) an ash that is soft, pliable, and non-sticking and that does not form "clinkers" while burning, (D) no tendency during normal storage conditions to undergo spontaneous combustion or auto-ignition, (E) adequate flow properties so that said fuel in powder form maintains fluidity and does not stick in the delivery system therefor, (F) insignificant tendency to pick up moisture during transportation or storage, (G) excellent ignition properties during cold weather starting in a cold furnace, and (H) excellent combustion properties for reducing carbon monoxide emission and soot formation and for improved heat recovery, which comprises the following steps: A. Grinding a coal or mixture of coals having a heating value of about 12,000 to 14,000 Btu to a fineness below 200 mesh; B. Drying the coal or coals with a hot gas, which is at 150° to 800°F and contains a trace amount of oxygen, to a dried moisture content of 1-15%; C. Blending the coal or coals with at least one additive selected from each group set forth below; (1) an SO2 scavenger for minimizing the effects of sulfur in said coal slected from the group consisting of limestone, lime, dolomite, gypsum, calcium phosphate, bauxite, and mixtures thereof, (2) a combustion improver and ash modifier for imparting burning properties and for reducing corrosion, fouling and ash slagging, selected from the group consisting of manganese dioxide, iron oxide, and manganese nodules.

COMBUSTION

REFER ALSO TO CITATION(S) 36001, 36607, 36825, 36827, 36966, 37038, 37083

35933 (DOE/ET/13152—3) **Measuring and modeling solids movement in a large, cold fluidized bed test facility. Third quarterly report, April 1-June 30, 1980.** Fitzgerald, T.J.; Mrazek, R.V.; Crane, S.D. (Oregon State Univ., Corvallis (USA). Dept. of Chemical Engineering). Jun 1980. Contract AC01-79ET13152. 70p. NTIS, PC A04/MF A01.

A considerable fraction of the apparent gas dispersion coefficient of a fluidized bed is due to a non-dispersive meander of the bed gas as it travels up through the bed. The experimental results indicate that a dispersion coefficient which is obtained by measuring the time average concentration at some location in the bed and then comparing the concentration to the tracer inlet rate will overestimate the real turbulent/molecular dispersion coefficient by as much as 60 to 70%. The meander coefficient was observed to vary from 0.0005 ft²/sec at a superficial velocity of 1.5 ft/sec (about 1.9 u_{mf}/

sub mf/) to about 0.068 ft²/sec at an air velocity of 6.0 ft/sec. The corresponding range in the turbulent/molecular dispersion coefficient was 0.004 ft²/sec to 0.10 ft²/sec. The meander coefficient shows a continued increase with air velocity whereas the turbulent/molecular coefficient was very close to the same value for the two highest velocities. There is some weak evidence of anisotropy in the meander dispersion coefficient. The turbulent/molecular coefficient seems to be independent of location.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 35915, 35916, 35917, 35918, 35920, 35921, 35925, 35926, 35932, 36825

35934 Impact of coal mine health and safety research. Forshey, D.R. (Bureau of Mines, Washington, DC). pp 13-28 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The Bureau's coal mine health and safety research program funding for FY 77 was as follows: Health and Safety Research, $36 million; Advancing Mining Technology, $69.7 million; Environment, $10 million for a total of $115.85 million. At the beginning of FY 78, a major part of the coal portion of the Advancing Mining Technology program was transferred to the Department of Energy. Also funding for Mine Health and Safety was increased to $49 million. The major program areas in mine health and safety research are: ground control, fire and explosion prevention, industrial hazards, methane control, survival and rescue, systems engineering, respirable dust, noise, radiation hazards, ventilation and industrial hygiene. Principal program areas for Coal Mine Health-Related Engineering Studies are respirable dust, noise control, and industrial hygiene.

35935 Safety is a three-way street. Evans, H.W. (Atlantic Richfield Co., Denver, CO). pp 29-48 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

In general, it may be concluded that the new Act and any subsequent implementing regulations will impose stricter safety and health requirements upon the operator, supposedly affords much better protection of the health and safety of the miner, attempts to expedite and simplify the collection of penalties against the operator and will cost the operator more money to comply. Undoubtedly the new regulations, when issued, will be stricter than the present MESA regulations. A vast majority of the provisions of the Act are to become effective 120 days after the enactment of the Act.

35936 Accident prevention principles. Zabetakis, M.G. (National Mine Health and Safety Academy, Beckley, WV). pp 49-58 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

In any organized occupational accident prevention program, a conscious effort must be made to determine the magnitude and acceptability of the risks associated with each procedure. With this logical basis, the modern program attacks accident causes at all levels. At the highest level, management must develop a suitable safety policy, furnish a safe and healthful workplace, procure suitable equipment and supplies, assign specific responsibilities at each level of authority, and hold each individual accountable for his actions. At the next level, each manager and first line supervisor must assume responsibility for his group and establish procedures to improve performance and reduce risks stressing education and training, job safety analysis (JSA), housekeeping, maintenance, inspections, accident investigations, etc. Additionally, each employee must become familiar with safe work routines and emergency procedures, and learn how to safely use all equipment and supplies with which he works. Where such measures fall short of an acceptable risk level, attempts must be made to protect the individual by reducing the available energy levels and quantities of hazardous materials. This may require using protective equipment and structures and altering work procedures to further reduce risk. These added safeguards are especially important in high risk industries where energy levels are excessive.

LEGISLATION AND REGULATIONS

REFER ALSO TO CITATION(S) 35924

35937 (ORNL/EIS—172) **US Department of Energy Environmental Compliance Program Handbook, Tennessee.** (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 316p. NTIS, PC A14/MF A01.

The US Department of Energy (DOE) has provided funding for a study of a coal conversion demonstration facility to be located in the State of Tennessee. Plans to fund the construction and operation of this facility in partnership with the city of Memphis were recently announced. This handbook identifies those Tennessee environmental laws, administrative rules and regulations, and permitting procedures that could affect the siting, construction, or operation of this facility. Areas of primary concern include air quality, water quality, solid waste disposal, and hazardous waste disposal. All entries are part of a computerized data base built and maintained for DOE at Oak Ridge National Laboratory.

35938 Overall impact of MESA's transfer to the Labor Department. Barrett, R.E. (Mining Enforcement and Safety Administration, Arlington, VA). pp 8-12 of Third Institute on Coal Mine Health and Safety. Leckie, W.E. (comp.). Golden, CO; Colorado School of Mines Press (1978).

From 3. institute on coal mine health and safety; Golden, CO, USA (30 Nov 1977).

The new act, PL 95-164, strongly emphasizes the protection of a miner's health and gives the Secretary of Labor the responsibility for issuing health standards rather than the Department of Health, Education and Welfare, as under the Coal Act. The purpose of the transfer of MESA from the Department of the Interior to the Department of Labor is most certainly not to downgrade MESA's mine health and safety activities. On the contrary, it is clearly spelled out in the new legislation that the ultimate goal is to upgrade mine health and safety at all US mining operations. The federal government has been involved for more than half a century with mine health and safety. We - and the mining industry - have had to adapt to legislative mandates in the past. In 1910, with the creation of the Bureau of Mines, this country made its first major commitment to the health and safety of miners. In 1952, enactment of public law 82-522 gave federal inspectors authority to issue notices of violations and orders of withdrawal, and all coal mines employing more than 15 miners were placed under federal regulatory authority. In 1966, with public law 89-376, the coverage was extended to all coal mines, and in that same year Congress passed the Federal Metal and Nonmetallic Mine Safety Act (public law 89-577). Three years later, the Federal Coal Mine Health and Safety Act of 1969 became America's broadest commitment to health and safety in coal mines. Now this Congress is attempting to continue and expand that commitment to mine health and safety.

PETROLEUM

35939 (DOE/BETC/QPR—80/1) **Liquid fossil fuel technology. Quarterly technical progress report, January-March 1980.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1980. 63p. NTIS, PC A04/MF A01.

Highlights of the BETC January-March 1980 quarter were: Gasohol was tested in a cooperative effort with Southwestern Bell Telephone Co. Two fleets of 55 cars were tested using gasohol in one and gasoline in the other. No problems were encountered. The gasohol-fueled cars had less emissions, and the fuel efficiencies for both fleets were approximately the same. An in situ combustion has been successfully started in a heavy oil deposit in Kansas. After some difficulties in starting the burn, it is now operating satisfactorily and producing oil. Cooperation between DOE and the Venezuelan oil industry was explored in a meeting at BETC that emphasized efforts to produce heavy oil. Cooperation through the International Energy Agency is expected to result in sharing of technology on enhanced oil recovery. Petroleum product surveys are produced cooperatively by DOE and the American Petroleum Institute. They give the properties of the products currently being marketed in the US. During the quarter, surveys on Motor Gasolines, Summer 1979 and Diesel Fuel Oils, 1979 were published. They are used to trace changes in characteristics and also to set specifications. The size of colloids, micelles, and emulsions in petroleum and associated liquids can be a factor in the design of improved recovery processes. The use of small angle x-ray scattering has been facilitated by a new method of calculation. The development of the Liquid Fossil Fuel Cycle has been facilitated by a workshop and further discussions resulting in a new statement Planning Framework for Liquid Fossil Fuel Cycle, March 1, 1980. This has now been used to prepare a computer-processible form to use in a critical path study of the BETC program.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 35963, 37123, 37130, 37366

35940 Formation testers . Brieger, E. (to Gearhart-Owen Ind Inc). US Patent 4,210,018. 1 Jul 1980. Filed date 22 May 1978. vpp.

A description is given of a method for use in obtaining multiple pressure tests of an earth formation traversed by a well bore by use of a sidewall fluid sampler well tool which has a fluid pressure sampling chamber in the well tool in open fluid communication with a pad sealing means, comprising the steps of: for one selected level in a well bore, moving a pad sealing means on the well tool into engagement with the wall of a well bore and isolating a wall segment of the earth formation; after the pad sealing means engges the wall segment of the earth formation, generating a hydraulic pressure in the well tool and applying said hydraulic pressure to said fluid pressure sampling chamber for increasing the volume of said fluid pressure sampling chamber thereby to dray a fluid sample from the earth formation engaged by the pad sealing means into the fluid pressure sampling chamber, sensing the pressure of said fluid sample as it is drawn into the fluid pressure sampling chamber while the volume of the sampling chamber is being increased, relieving the hydraulic pressure in the well tool with respect to said fluid pressur sampling chamber for decreasing the volume of said fluid pressure sampling chamber thereby to contact the sampling chamber to dischrge the fluid sample through the pad sealing means; retracting the sealing pad means and, after retrction of sealing pad means from engagement from the wall of the well bore, moving the well tool to a second location at another level in the well bore and, at the second location, repeating the steps of the method performed at the one selected level for obtaining another fluid sample and pressure sensing at said second location.

35941 Synergetic log and core analysis program using a laminated shale-dispersed clay sandstone model. Haley, R.A. (Shell Oil Co., New Orleans, LA). pp 24p, Paper F of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

LAMIS1 is a computer-processed formation evaluation technique for sandstones. LAMIS1 treats laminated shale and dispersed clay as distinct entities. Hydrocarbon effects are exactingly treated. The logging suite utilized by LAMIS1 includes resistivity, density, gamma ray, compensated neutron (optional), and flushed zone resistivity (R/sub xo/-optional). The five nonlinear log response equations are solved in terms of water saturation, flushed zone water saturation (s/sub xo/), matrix porosity, volume of dispersed clay, and volume of laminated shale. These values are then expanded into other petroleum engineering quantities such as net feet, permeability, and A.P.I. estimates of recoverable oil. Verification techniques are incorporated in the program. LAMIS1 has been successfully used in Gulf Coast Pleistocene, Miocene, Hosston (Cretaceous), and Texas Woodbine sands. Several examples are given.

35942 Practical applications of the relationship between lithologic factor and pore geometrical factor. Barlai, Z.; Mawla, R.A. (Al-Fateh Univ., Tripoli, Libya). pp 22p, Paper J of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

In 1978, a theoretical study was published about two intrinsic reservoir parameters, the lithologic influence factor, C, and the pore geometrical factor, G, with emphasis on their correlation. The parameters C and G are characteristic to the composition and poresize distribution of nonuniform sandstones, thus their knowledge is very useful in any detailed reservoir studies and project works. In this paper some practical applications of C and G are shown, and determination of G from C is also presented. Hydraulic goodness of the rock is properly qualified by the permeability-porosity quotient,, K/phi, which in turn, can be determined from C. Capillary behaviour of the reservoir is well characterized by a definite integral which also can be obtained from C. Displacement pressure, P/sub d/ , of the rock is determined also from C. Complexity of the pore radii distribution is fairly estimated from the pore geometrical factor, G, which, in turn, is determined from the lithologic influence factor, C.

35943 Twenty years later: are log analysts still important. Haas, M.W. pp 7p, Paper K of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The paper recaps where oil and gas industry has come in the last twenty years, evolutions in logging, contributions of log analysts, the role of SPWLA, and a look at the future. Production worldwide has exceeded our projections of twenty years ago, but will probably grow at a much slower rate over the next few years. Domestic activity should continue to grow, although the nature of exploration is shifting, and other energy and minerals extraction will become important. We have witnessed a big improvement in logging quality, reliability, and tool combinations, and should see dramatic advances in computer processing and data transmission. Log analysts have emerged as key members of exploration and production teams, and will become more important, in even broader activities. By correlation, the role of SPWLA has grown in several important areas, and this growth will be sustained.

35944 Log evaluation of a fractured reservoir Monterey Shale. Cannon, D.E. (Schlumberger Well Services, Ventura, CA). pp 14p, Paper Q of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Over a large area, the Miocene rocks in California contain a massive section called the Monterey Shale. Because of its complex lithology (siliceous shale, chert, diatomite, opaline, limestone, sand, dolomite, and clay) and the fact that fracture systems appear to provide most of the permeability for production, classical log analysis has been unable to clearly define the producing sections. These sections, however, can be qualitatively identified by an unconventional use of basic logs. The method involves determining zones containing movable hydrocarbons (R/sub t/ vs R/sub xo/) and comparing two indices, Sonic Matrix Index (SMI) vs Crossplot Matrix Index (XMI) over the same zones. When the conditions R/sub t//R/sub xo/ $>$ 1 and SMI at least 10% greater than XMI are satisfied, commercial production is indicated. The method has been applied to twenty-one wells. Of these, twelve have been tested selectively enough to evaluate the method. In all these, test results are in agreement with log analysis. Computed logs, generated from field tapes, illustrating the method are shown.

35945 Semiquantitative technique for predicting producibility limits of reservoirs by well log analysis. Gomez-Rivero, O. (Petroleos Mexicanos, Mexico City, Mexico). pp 10p, Paper S of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

An approach is presented for predicting ranges of the absolute permeability index of sands and carbonate reservoir rocks using only well logs. The method is more qualitative than quantitative. Nevertheless, an equation relating formation resistivity factor with absolute permeability, K, is given for computing average values of absolute permeability, which allows for an order of magnitude of this reservoir parameter. Unlike the generality of the common similar methods, porosity is not the only directly involved parameter; this particular characteristic makes the method be applicable even to fractured rocks. The method requires, however, the use of nuclear porosity index logs, such as neutron and density gamma-gamma, but for rocks with predominantly primary intergranular, sand-type-porosity, acoustic - porosity logs can also be used with confidence. As connate water saturation calculation is an unavoidable step in the computation procedure, suitable R/sub t/ and R/sub xo/ logs are required in addition. It is concluded that it is possible to compute real values of permeability index, eliminating much of the ambiguity that arises when porosity is the only variable, by introducing the formation resistivity factor as another variable.

35946 Practical method of well evaluation and acreage development for the naturally fractured Austin Chalk formation. Schafer, J.N. (ConVest Energy Corp., Houston, TX). pp 27p, Paper U of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The geometry of a borehole intersecting vertical fractures has been observed with the dipmeter tool. Fracture size can be qualitatively measured by recognizing characteristic dipmeter responses. The dipmeter locates pay zones in Austin Chalk so it can be used for perforation selection. Austin Chalk vertical fractures are subsurface joint planes which can be directionally oriented with the dipmeter. In the Pearsall Field area, a predominant joint set strikes N37°E/S37°W and a possible secondary set N50 to 51°E/S50 to 51°W. A quantitative expression of well productivity called the fracture index relates fracturing as measured by four dipmeter parameters to initial average daily production.

35947 Systems approach to large scale exploratory drilling ventures. Rieke, H.H. III (TRW, Inc., Morgantown, WV); Skillern, C.R.; Rightmire, C.T.; Overbey, W.K. Jr. pp 19p, Paper V of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A systems approach was employed to identify the EGSP and MRCP coring and logging objectives and to define the elements of configuration, data and logistics management, whereby the stated objectives would be achieved. The resultant coring and logging plan contains a work breakdown structure which generically details the logical reduction of the various operations. It contains event sequence diagrams which are used to delineate and schedule the specific tasks which will implement the planned objectives in the planning, field, laboratory and data processing operations. The coring and logistics arrangements and procedures are specified for sampling, handling and core analysis in the field and laboratory.

35948 Application of cation exchange capacity in a study of the Shannon Sand of Wyoming. Keelan, D.K. (Core Labs., Inc., Mt. Pleasant, MI); McGinley, D.C. pp 21p, Paper W of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Downhole log data are utilized with laboratory determined cementation exponents, saturation exponents and cation exchange capacities to furnish improved values of reservoir water saturation in the Shannon Sand of the Teapot Dome Field. Shaly sand effects are important in this reservoir. Significant errors result in calculated water saturations, and hence oil-in-place if clean sand analysis techniques are utilized and shale effects are ignored. Waxman-Smits-Thomas equations were employed in this study. Examples present a calculation format, outline of procedures and illustrate the calculation of F*, m*, a* and n* by combining the laboratory electrical property data with measured cation exchange capacities. Also shown are the effects of several incorrect procedures to be avoided when utilizing the Waxman-Smits-Thomas approach. These include combination of the cation exchange data with a non-applicable formation factor-porosity relationship, use of an improper water resistivity when calculating F*, m*, a* and n* from laboratory tests, and improper use of porosity and grain density data generated on a core dried with controlled humidity in order to leave two molecular layers of water on the clay surfaces.

35949 Pyrite in carbonate rocks: a computer technique. Davis, D.G. pp 29p, Paper Y of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The presence of pyrites within potentially productive carbonate rock is a deterrent to the log analyst obtaining valid results when attempting to calculate reservoir parameters from logs using standard evaluating techniques. Not only are pyrites a problem to resistivity or conductivity devices because of their metallic effects but their high densities distort the results obtained from the commonly used crossplot techniques for evaluating porosity and subsequently, water saturations. This paper does not deal with the resistivity problem other than describing it and recommending use of certain types of tools to minimize its effect. With regard to the high density problem, a technique is developed which will allow the log analyst to recognize the presence of pyrite, to estimate its fractional amount, and to compensate for its presence in the calculation of porosity. Although the technique is intended as a general one, examples of its application are limited to the Khuff formation in the Dukhan field, Qatar.

35950 Central role of Q/sub v/ and formation-water salinity in the evaluation of shaly formations. Juhasz, I. (Koninklijke/Shell Exploratie en Produktie Laboratorium, Rijswijk, The Netherlands). pp 26p, Paper AA of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A new evaluation approach, covering both the fluid saturation and producibiity aspects of shaly formations, is presented. The approach is based on the combined use of the total and effective porosity systems linked via the parameters Q/sub v/ (cation-exchange capacity per unit total pore volume) and formation-water salinity. The quantity Q/sub v/ is calculated from the FDC/CNL on the basis of clay-mineralogical data obtained from cores or sidewall samples. Q/sub v/ is then used to calculate both the total water saturation, via the Waxman-Smits equation, and the amount of clay-bound water (CBW), via the Hill, Shirley and Klein equation. The latter parameter, in turn, facilitates estimation of the effective porosity and, if desired, the effective water saturation, correction of air-mercury capillary-pressure curves for CBW, and conversion of air permeabilities into brine permeabilities. In this approach all input parameters required for the evaluation are obtained from the interval under study; the use of clay parameters obtained from adjacent shale beds is thus avoided. Furthermore, all quantities playing a role in the evaluation are interdependent via the parameters Q/sub v/ and formation-water salinity. This enhances internal consistency and reliability of the results obtained.

35951 Theory and application of capillary pressure. Evans, C.E.; Guerrero, E.T. (Univ. of Tulsa, OK). pp 20p, Paper MM of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Petroleum engineering uses of capillary pressure are discussed, along with ways to develop capillary pressure curves. The methods discussed are: (1) core analysis, and (2) well logs. The advantages and disadvantages of each method are examined. Well logs are intrinsically the best methods to measure the water saturations in the formation. This is because the formation is only altered by the drilling process and not by subsequent removal of overburden pressure and cleaning in the laboratory. In oil-bearing formation with an underlying aquifer and a zone which produces water-free, the entire capillary pressure curve can be developed with knowledge of the densities of the oil and water in the formation. In closed reservoirs, the saturation calculated from well logs should be used to normalize the laboratory developed capillary pressure curve.

35952 Determination of porosity in sandstones and shaly sandstones. Part one: quality control. Patchett, J.G.(Amoco Production Co., Tulsa, OK); Coalson, E.B. pp 17p, Paper QQ of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The complex mineralogy of some sandstones and shaly sandstones can make the accurate determination of porosity from logs difficult, if not impossible. The solution of this problem can require either petrophysical data often not available or logging measurements that are not developed or a least not routinely currently available. Petrophysical data obtained from cores are subject to errors in measurements and sampling. Even in quartz sandstones, systematic errors in logging measurements can make consistently reliable porosity calculations impossible without careful verification of log response. As an example, significant errors are present in a large minority of density logs. This report includes examples, obtained during field studies, of the results of log quality surveillance. In some of these investigations, porosity measured from cores was also seriously in error, making the verification of the quality control effort difficult.

35953 Application of radial differential temperature (RDT) logging to detect and treat flow behind casing. Cooke, C.E. Jr. (Exxon Production Research Co., Houston, TX); Meyer, A.J. pp 10p, Paper UU of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A new logging method, called Radial Differential Temperature or RDT logging, has been developed which measures the difference in temperature at different points inside the casing wall. This new method has been used to detect vertical flow of liquid or gas outside the casing. Temperature sensors on the tool are extended and the tool is rotated at a selected depth in the wellbore to locate a flow channel behind casing. Rotation of the tool can be stopped, the arms retracted, and a perforating gun, attached below the tool, can be fired in the direction of the flow channel. The tool has been applied in South Texas where isolating hydrocarbon-bearing zones from nearby water zones has been a recognized problem in the industry for many years. Examples of application of the new logging method in workover operations are cited, along with the procedures used. The new method should have wide applicability in wells where quality of the cement seal is questionable.

35954 Dielectric constant logging: a progress report. Berry, W.R. II; Head, M.P.; Mougne, M.L. (Go Wireline Services, Fort Worth, TX). pp 26p, Paper VV of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The recent evolution of equipment capable of measuring the relative dielectric constant of a formation has stimulated new approaches to the evaluation of water saturation. In many oil productive reservoirs, the formation water resistivities are either unknown or are very high, complicating conventional resistivity-dependent solutions for water saturation. By determining the relative dielectric constant of the formation and through application of the Lichtnecker and Rother equation for the dielectric constant of mixtures, the analyst may identify the presence of hydrocarbons and in many cases, quantify reserves. Additionally, a quick look overlay technique for qualitative evaluation can be utilized. These procedures

can be of great help in both exploration and development environments where conventional methods have led to confusion. 28 figures.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 35988, 35999, 36000, 36621, 36752

35955 (DOE/BC/10068—16) **Interfacial effects in the recovery of residual oil by displacement: studies at Northwestern University. Annual report, March 1979-February 1980.** Slattery, J.C. (Northwestern Univ., Evanston, IL (USA)). Oct 1980. Contract AC19-79BC10068. 110p. NTIS, PC A06/MF A01.

The primary goal of this work is to determine the relative effects of the interfacial viscosities, of interfacial tension, of advancing contact angle, and of receding contact angle upon the relative permeability and capillary pressure functions. The optimal design of a tertiary recovery flooding process depends upon the ability to anticipate how changes in the interfacial viscosities, interfacial tension, and the wetting characteristics of the porous medium will affect the relative permeability and capillary pressure functions. Analysis of displacement in a cylindrical pore is completed. A study is underway on displacement through an irregular pore, the diameter of which is a sinusoidal function of axial position. As a bubble or drop is forced towards a phase interface, a thin film forms, drains, becomes unstable, and coalescence occurs. Two papers have been finished that discuss the drainage of thin liquid films. It appears that the surface viscosities may play a minimal role in the drainage process. No judgment is possible from these analyses about the effect of the interfacial viscosities upon the stability of a film or, ultimately, upon coalescence. A structural model for a porous medium is developed in the form of a randomized, three-dimensional network that can be employed to correlate for a given system the single-phase permeability, the drainage and imbition capillary pressure curves, and the two drainage relative permeability curves as measured during steady-state flows. The subsequent portions of the hysteresis loops for capillary pressure and for the relative permeabilities then can be predicted. Torsional (the knife-edge, disk, and thin biconical bob) surface viscometers have been redesigned in a simpler and more sensitive configuration.

35956 (DOE/BETC—80/2) **Contracts for field projects and supporting research on enhanced oil recovery and improved drilling technology. Progress review No. 22, quarter ending March 31, 1980.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jul 1980. 150p. NTIS, PC A07/MF A01.

This report contains statements of objectives and summaries of technical progress on all DOE contracts pertaining to enhanced oil recovery and improved drilling techniques. Subject categories include chemical flooding; carbon dioxide injection; thermal recovery of heavy oil; resource assessment; improved drilling technology; residual oil; environmental; petroleum technology; and microbial enhanced oil recovery. An index containing the names of the companies and institutions involved is included. Current publications resulting from the DOE contractual program are listed. (DMC)

35957 (DOE/BETC/RI—80/4(Rev.)) **Technical constraints limiting application of enhanced oil recovery techniques to petroleum production in the United States.** (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Sep 1980. 25p. NTIS, PC A02/MF A01.

A cost-shared program was initiated in 1974 to accelerate the application of advanced EOR processes. An incentive program was also announced in 1979 for the commercialization of EOR techniques. This report provides a summary of the EOR state-of-the-art and draws upon the data base developed thus far. A critical review of four major cost-shared chemical projects is included. Chemical recovery, miscible recovery, and thermal recovery techniques are covered. The FY 1979 DOE EOR program is summarized in a table. (DLC)

35958 (DOE/MC/10689—3) **Mobility control for CO_2 floods: a literature survey.** (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Oct 1980. Contract AC21-79MC10689. 142p. NTIS, PC A07/MF A01.

Of all the Enhanced Oil Recovery (EOR) processes, flooding by carbon dioxide offers the brightest promise, both of significant increases to the Nation's oil supply, and of availability in the near term. A way must be found to control severe frontal instabilities which seriously degrade the efficiency of the displacement of crude oil through the pore space of the reservoir rock by the less viscous CO_2. Of currently operational EOR projects, CO_2 floods are second in number only to those heavy oil recovery projects which use steam. However because of frontal instability, CO_2 floods are liable to early CO_2 breakthrough, and to flooding inefficiency that will cause premature production decline. This Literature Survey is part of a laboratory research project which seeks practical methods of mobility control for CO_2 floods. The development of such methods should be very cost effective because the dissemination of information about them throughout the industry will persuade operators that enhance oil production from CO_2 floods can be sustained by increased displacement efficiency. 151 references.

35959 Method for plugging high permeability zones in subterranean reservoirs . Christopher, C.; Clauset, A. (to Texaco Inc). US Patent 4,210,204. 1 Jul 1980. Filed date 7 Feb 1979. vpp.

A description is given of a method for plugging high permeability areas within a subterranean reservoir penetrated by at least one injection well and at least one production well, said wells being in fluid communication with each other, comprising infecting through at least one of said wells an effective amount of an aqueous solution comprising fresh wter and a pectic substance selected from the group consisting pectins, pectates, polygalacturonic acids and mixtures thereof into said high permeability areas wherein the aqueous solution contacts a brine which causes the pectic substance to form a gel thereby effectively plugging the high permeability areas within the reservoir.

35960 High temperature well treating with crosslinked gelled solutions. Ely, J.; Tinsley, J. (to Halliburton Co). US Patent 4,210,206. 1 Jul 1980. Filed date 11 Oct 1978. vpp.

A description is given of a method of treating a well formation existing at a temperature in the range of from about 120°F to about 350°F with a temporary blocking agent comprising the steps of: preparing a temporary blocking agent composition which forms a highly viscious crosslinked gel at the temperature of said well formation, said composition being comprised of water, a gelling agent present in the range of from about 1 to about 13 parts by weight per 100 parts by weight of said water and selected from the group consisting of water soluble polysaccharides having a molecular weight of at least about 100,000, said water soluble polysaccharides crosslinked with a compound selected from the group consisting of dialdehydes having the general formula: $OHC(CH_2)$/sub n/CHO, wherein n is an integer within the range of 0 to about 3, 2-hydroxyadipaldehyde, diemthylol urea, water soluble urea formaldehyde resins, water soluble melamine formaldehyde resins, and mixtures thereof, water soluble polyacrylamides and mixtures thereof, and hexamethyoxymethylmelamine present in the range of from about 0.05 to aboiut 5 parts by weight per 100 parts by weight of said water; and introducing said composition into said well formation whereby said composition is heated to a temperature in the range of from about 120°F to about 350°F and formed into a highly viscious crosslinked gel in said formation.

35961 Valve apparatus . McStravick, D.; Roberts, W. (to Baker International Corp). US Patent 4,210,207. 1 Jul 1980. Filed date 14 Mar 1979. vpp.

A description is given of a valve apparatus for use in subterranean well and carriable on a fluid transmission conduit insertable therein, comprising: ball valve head means having camway slot means defined exteriorly theron; valve seat means having camway ball means secured thereto and carriable in said camway slot means to pivot said valve head means on said seat means to shift said appartus between open and closed positions in response to manipulation of said fluid transmission conduit.

35962 Subsea choke and riser pressure equalization system . Shanks, F. (to Sedco Inc). US Patent 4,210,208. 1 Jul 1980. Filed date 4 Dec 1978. vpp.

A description is given of a subsea choke and riser pressure equalization system comprising, in combination: a section of riser pipe; a choke conduit line mechanically supported by said riser pipe; a variable choke valve having an inlet port and a discharge port; a gate valve having an inlet port and a discharge port; a gate valve having an inlet port conected in fluid communiction with the choke line and an output port connected in fluid communication with the inlet port of the variable choke for permitting diversion of fluid from the choke line to the variable choke; and, means connecting the discharge port of the variable choke in fluid communication with the interior of the riser section, said means including a discharge conduit extending from said choke valve in inclined relation with respect to the axis of said riser, whereby fluid diverted from said choke conduit is discharged into said riser in counterflow relation with respect to the upward flow of drilling fluid through said riser.

35963 Dynamic visual display of reservoir simulator results . Good, P.; Rogers, W.; Smith, R. (to Shell Oil Co). US Patent 4,210,964. 1 Jul 1980. Filed date 17 Jan 1978. vpp.

A description is given of a method for producing a dynamic visual display of the variation with time along a surface of physical characteristics of a producing petroleum reservoir wherein the magnitude of each characteristic is calculated for each of a series of times, a series of steps comprising: assigning color (tint), intensities and saturations (perceived whiteness) to various values of the magnitude of each characteristic; producing for each one of said series of

times a visual display of the variation in the magnitude of each characteristic along the surface using the assigned color, intensity, and saturation, to represent the magnitude of the characteristic; forming a separate photographic record of said visual display for each of said series of times; and, displaying a sequence of said photographic records to form a dynamic display of the variation with time along said surface of said variation.

PROCESSING

35964 Combination of ethylene polymer, normal paraffinic wax and nitrogen containing compound (stabilized, if desired, with one or more compatibility additives) to improve cold flow properties of distillate fuel oils . Dooley, M.; Feldman, N.; Ryer, J. (to Exxon Research And Engineering Co). US Patent 4,210,424. 1 Jul 1980. Filed date 3 Nov 1978. vpp.

A description is given of a wax-containing petroleum fuel oil comprising a major proportion of a distillate oil boiling in the range of 120° to 42 5° C, which fuel oil has been improved in its low temperature flow properties, containing in the range of about 0.001 to 2.5 wt. %, based on the weight of the total composition, of a flow improving combination of: (A) one part by weight of an oil-soluble ethylene backbone distillate flow improving polymer having a number average molecular weight in the range of about 500 to 50,000; (B) 0.1 to 30 parts by weight of wax comprising principally n-paraffins having from 20 to 60 carbons; and (C) 0.01 to 10 parts weight of an oil-soluble nitrogen compound containing a total of about 30 to 300 carbon atoms and having at least one straight chain alkyl segment of 8 to 40 carbons, and selected from the class consisting of amine salts and/or amides of hydrocarbyl carboxylic acids or anhydrides having 1 to 4 carbonyl groups.

35965 Glycol polyether-acrylic acid-amine reaction product for fuel and mineral oils . Cummings, W. (to Texaco Inc). US Patent 4,210,425. 1 Jul 1980. Filed date 26 Sep 1977. vpp.

A description is given of a motor fuel composition comprising a mixture of hydrocarbons in the gasoline boiling range and a glycol polyether reaction product represented by the formula: HO-CH(-CH3)-CH2-O-(CH2-CH(-CH3)-O)N-CH2-CH(-CH3)-OOC-CH2-CH2-NH-R in which N is a number from about 10 to 90 and R is a monovalent hydrocarbon radical having from about 2 to 30 carbon atoms or a radical selected from the group represented by the formulas: (CH2CH2nH)X-H or C(CH2-CH2-CH2nH)Y-H in which X and Y are integers from 1 to 6.

35966 Process and apparatus for hydrocarbon conversion. Boret, R.; Bronner, C.; Huin, R.; Vidal, A. (to Institut Francais Du Petrole (France)). US Patent 4,210,519. 1 Jul 1980. Priority date 16 Nov 1971, France. vpp.

A description is given of a process for the continuous conversion of hydrocarbons, in the presence of granular catalyst containing a carrier and at least one metal selected from the group consisting of metals from groups VI a, VII a and VIII of the periodic classification of the elements, comprising circulating a charge formed of hydrogen and hydrocarbons through a reaction space comprising at least two elementary catalytic zones, connected in series, substantially vertical and placed side by side, each of them being of the moving bed type, the charge circulating successively through each zone and the catalyst also passing successively through each zone and moving continuously downwardly therethrough, continuously withdrawing the catalyst from the bottom of the last catalytic zone, passing resultant withdrawn catalyst to an accumulator, and from the accumulator sending the catalyst to a fixed bed regeneration zone, isolating fixed bed regeneration zone from the process duringiregeneration, the catalyst in the regeneration zone where,eforming a fixed bed, it is successively subjected in the form ofrsaid fixed bed (A) to a combustion by means of a gas containingamolecular oxygen whose oxygen content by volume is from 01 to 1%, (B) to an exychlorination by means of a gas containing molecular oxygen content by volume is from 1 to 3% and simulataneously by means of at least one alkyl halide, and (C) to a final oxidation treatment by means of an oxygen-containing gas whose oxygen content by volume is from 3 to 20%, passing resultant regenerated catalyst to a reducing zone and from which the reduced catalyst is progressively reintroduced into the upper part of the first catalytic zone of the reaction space so as to maintain a substantially constant high level of activity in each point of the catalytic zones.

35967 Unsupported catalysts in the production of olefins . Kreuter, W.; Wernicke, H. (to Linde Ag (Germany, F.R.)). US Patent 4,210,520. 1 Jul 1980. Priority date 12 May 1977, German, Federal Republic of (F.R. Germany). vpp.

A description is given of a process for the production of olefins in two stages wherein, in the first stage, a heavy petroleum fraction is hydrogenated essentially in the liquid phase in the presence of hydrogen and a hydrogenation catalyst and, in the second stage, the thus-hydrogenated fraction is subjected to thermal cracking in the vapor phase in the presence of steam, the improvement which comprises employing as the hydrogenation catalyst a support-free catalyst consisting essentially of at least one of Co-Mo, Ni-Mo, Co-Mo sulfide, Ni-Co-Mo sulfide, Ni-Mo sulfide, Ni-Co sulfide, Co-mo oxide, Ni-Co-Mo oxide, Ni-Mo oxide, Ni-Co oxide, Ni-W sulfide, Ni-W oxide, or organometallic complexes of aforementioned metallic mixtures.

35968 Catalytic upgrading of refractory hydrocarbon stocks. Gorring, R.; Smith, R. (to Mobil Corp). US Patent 4,210,521. 1 Jul 1980. Filed date 2 May 1979. vpp.

A dual bed process for upgrading a refactory hydrocarbon feed, characterized by a bromine no. Greater than about 10 and an aromatics content of at least about 40 weight percent, which comprises contacting a stream of said feed initially in a hydrotreating zone containing a bed of hydrotreating catalyst under reaction conditions which include a pressure within the range of about 100° to about 1800 psig, a temperature between about 550°F and about 850°F in the presence of between about 2.4 and about 24 moles of hydrogen/mole of hydrocarbon charge to convert sulfur and nitrogen derivatives of hydrocarbon to hydrogen sulfide and ammonia; passing the entire effluent from said hydrotreating zone to a hydrocracking zone containing a bed of hydrocracking catalyst comprising a crystalline aluminosilicate zeolite characterized by a silica to alumina ratio of at least about 12 and a constraint index within the approximate range of 1 to 12 in combination with a metal component exhibiting hydrogenation-dehydrogenation activity under reaction conditions which include a pressure within the above stated range, a hydrogen concentration between about 2 and about 23 moles of hydrogen per mole of charge to said latter zone and a temperature between about 650°F and about 950°F and recovering gasoline of high octane number directly as a product of the aforenoted dual bed sequential operation.

35969 Hydrocracking catalyst . Hilfman, L.; O'Hara, M. (to Uop Inc). US Patent 4,210,522. 1 Jul 1980. Filed date 25 Oct 1978. vpp.

A description is given of a process for the conversion of heavy hydrocarbon oil boiling above about 650°F into lower boiling hydrocarbons, which comprises hydrocracking the heavy oil in admixture with hydrogen and in contact with a catalyst with comprising a ra re earth exchange metal component and a platinum group metal component supported on a mixture of ziegler alumina and a zeolite.

35970 Hydrocarbon conversion with a superactive multimetallic catalytic composite containing two different types of rhenium sites . Antos, G. (to UOP Inc). US Patent 4,210,523. 1 Jul 1980. Filed date 21 Feb 1979. vpp.

A description is given of a process for converting a hydrocarbon which comprises contacting said hydrocarbon at hydrocarbon conversion conditions with a catalytic composite comprising a reduced combination of a catalytically effective amount of an adsorbed rehnium-oxygen with a porous carrier material containing catalytically effective amounts of rhenium component other than that derived from said rhenium-oxygen complex and a platinum group component wherein said platinum group component is uniformly dispersed in the carrier material and is maintained in the elemental metallic state during adsorption and reduction of the rhenium-oxygen complex is adsorbed on the surface of the platinum group component prior to the reduction of the rhenium-oxygen complex.

35971 Hydrocarbon conversion with a superactive multimetallic catalytic composite containing two different types of rhenium sites . Antos, G. (to UOP Inc). US Patent 4,210,524. 1 Jul 1980. Filed date 7 Mar 1979. vpp.

A description is given of a process for converting a hydrocarbon which comprises contacting said hydrocarbon with a catalytic composite comprising a combination of a catalytically effective amount of a pyrolyzed rhenium carbonyl component with a porous carrier material containing a catalytically effective amount of a noncarbonyl derived rhenium component and a uniform dispersion of catalytically effective amounts of a platinum group component, which is maintained in the elemental state during the incorporation of said rhenium carbonyl component.

35972 Hydrodenitrogenation of demetallized residual oil . Peters, A. (to Mobil Corp). US Patent 4,210,525. 1 Jul 1980. Filed date 24 Apr 1979. vpp.

A description is given of a process for preparing a high quality catalytic feedstock from a residual oil, which process comprises treating said oil to reduce the metals content thereof to a metals factor of less than 50 thereby forming demetallized residual oil, and contacting said demetallized oil in the presence of hydrogen at a temperature of 600° to 850°F, a pressure of 500 to 3000 psig, and a liquid hourly space velocity of 0.1 to 10.0 with a denitrogenation catalyst comprising the oxides or sulfides of a group vib metal and an iron group metal on an acidic porous refractory oxide, said catalyst having at least 80% of its pore volume in pores up to 50 Angstroms diameter.

35973 Desulfurizing fossil fuels . Swanson, R. US Patent 4,210,526. 1 Jul 1980. Filed date 16 Jun 1978. vpp.

A description is given of a process wherein petroleum residues are desulfurized by treating with at least 0.25 volume thereof of an alkali metal monosulfide hydrate reagent at a process temperature of between about 120° and 325°C from about 3 to 60 minutes: separating said residues now having a reduced sulfur content from the corresponding alkali metal polysulfides, the improvement which comprises the steps of: (A) separating at said process temperature a mixture of unreacted alkali metal monosulfide hydrate and alkali metal polysulfides from said desulfurized residue; (B) hydrolizing in a closed system said polysulfides by adding to said mixture at said temperature at least one mol of water per mol of hydrate and polysulfide thereby forming steam and hydrogen sulfide; (C) removing said steam and said hydrogen sulfide from said system thereby reducing the water content therein to that of the alkali metal monosulfide hydrate and separating the highest sulfur content polysulfide from the said hydrate.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 35958, 36752

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 36752

35974 (DOE/RG/10073—T1) **Preparation, assembly and entry of data into the SPEAKEASY data base. Final report.** (National Inst. for Community Development, Inc., Arlington, VA (USA)). Feb 1980. Contract AC01-79RG10073. 64p. NTIS, PC A04/MF A01.

The purpose of this study was to provide assistance of non-policy nature in preparing data bases relating to the supply demand and price of crude oil, natural gas and other petroleum products. The data bases were to be used in determining the impact of decontrol of oil prices, announced by the President on April 5, 1979, on oil production, conservation of existing energy supplies, development of alternative energy sources, and dependency on foreign oil.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 36852

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 35976, 37235, 37250

35975 (AD-A—079714/2) **Oil pollution response planning guide for extreme weather.** (Seaward International, Inc., Falls Church, VA (USA)). 16 Nov 1979. Contract DOT-CG-80372-A. 238p. NTIS, PC A11/MF A01.

This Guide is intended to provide the On-Scene Coordinator with information and guidance useful in developing action plans and contigency plans for conducting oil pollution response operations in open water. The Guide considers two general categories of response operations at sea: (1) Prevention of (further) spillage from tanker and other vessel casualties. (2) Oil spill mitigation and cleanup. The following types of information are presented in the guide: (1) Outlines for Action Plans. (2) Planning guidance. (3) Requirements for initial casulty assessment. (4) Roles of ship's master, Salvor, other key personnel. (5) Description of response system and equipment options. (6) Data needs for use in selecting appropriate response approach. (7) Selection criteria for deciding between alternative response approaches. (8) Checklists for various types of the response operations, and (9) Sources for additional information.

LEGISLATION AND REGULATION

35976 Environmental impact statement: OCS oil and gas proposed 1981 sales A66 and 66. Bartz, M.R.; Verinder, S.H. (comps.). New Orleans, LA: New Orleans Outer Continental Shelf Office (1980). 175p.

2 overlays of proposed tracts and 2 visuals for lease status are attached.

Proposed OCS Sales A66 and 66 are scheduled for July and October 1981 in accordance with the Department of the Interior's Proposed Final OCS Oil and Gas Leasing Schedule. This draft environmental impact statement (DEIS) covers both sales due to the geographic and chronological proximity of the sales to each other. An index has been provided and lists information relative to specific data and impacts. The proposed sales of oil and gas leases in the Gulf of Mexico consist of 1,979,794 acres in 385 tracts offshore the states of Texas, Louisiana, Mississippi, Alabama, and Florida. Of these tracts, 209 tracts comprise Sale 66 and 176 tracts comprise Sale A66. The tracts vary from 3 to 116 nautical miles from shore in water from 2000 to 5000 meters deep. Basic assumptions for impact estimates and analysis of potential environmental consequences are presented. In the area of transportation, the mean resource estimate development scenarios assume production offshore Texas and Louisiana will be transported to shore by connecting to existing truck pipelines. Production offshore Florida will be gathered by new pipelines to a central point for storage and transfer by shuttle tankers to existing onshore processing facilities. (DP)

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 35964

35977 Petroleum storage and transportation capacities. Volume III. Petroleum pipeline. Washington, DC; National Petroleum Council (1979). 181p.

Capacity data as of December 31, 1978, are presented for common carrier crude lines, refined petroleum product lines, and liquified petroleum gas/natural gas liquids (LPG/NGL) lines in the form of maps and tables. The maps include: a United States map, including all lines, for crude lines, petroleum product lines, and LPG/NGL lines, each separately; and Petroleum Administration for Defense (PAD) maps for crude and petroleum product lines, each separately. Tables presenting more detailed information than contained on the maps and intended to be used as a supplement to them are included in the Appendices. Several significant trends have developed in the years since the 1967 report was published. The United States has imported increasing amounts of foreign crude oil to supplement its declining domestic production. This foreign crude oil is imported through water terminals and their associated facilities and distributed through petroleum pipelines to inland refineries. Major amounts of imported crude oil are transported by pipeline from the Gulf Coast to the Central and upper Midwest refineries. The trend at the present time is to mix these individual crude oils having similar qualities and deliver the mixes to the refineries. Also, it has become common to batch various combinations of crude oil, refined product, LPG, and petrochemicals through a single pipeline. This ability to ship various petroleum materials in a single pipeline has enhanced the flexibility of the pipeline network.

35978 Petroleum storage and transportation capacities. Volume IV. Tank cars/trucks. Washington, DC; National Petroleum Council (1979). 82p.

In this report of the Tank Cars/Trucks Task Group, a demographic breakdown and a geographic analysis of the US rail tank car fleet, and the number of tank vehicles, with a capacity in excess of 3500 gallons, which might be called upon to safely haul petroleum products (including LPG and LNG) in the event of a national emergency are presented. In the appendices there are detailed information on DOT tank car specifications, analysis of tank cars suitable to haul petroleum in an emergency, geographic distribution of tank cars, NPC 1979 survey of tank vehicles, and tabulation of NPC 1979 tank vehicle.

35979 Petroleum storage and transportation capacities. Volume V. Waterborne transportation. Washington, DC; National Petroleum Council (1979). 106p.

The Waterborne Transportation Task Group's report covers the following items: update of the 1967 NPC inventory of waterborne petroleum transportation equipment, noting equipment age; report on permanent river and lake facilities; including US coastal petroleum receiving facilities with access to US refineries and Puerto Rico and Virgin Island refinery receiving facilities; and an examination of constraints on waterborne transportation facilities, such as weather-related (seasonality) and facility-related constraints, with special attention to facility constraints at strategic locations. Detailed information on petroleum receiving facilities, permanent navigation facilities, and waterborne transportation equipment is tabulated in the appendices.

PROPERTIES

REFER ALSO TO CITATION(S) 36971

35980 Oxidation resistant lubricant composition . Lee, R.; Richardson, E. (to Standard Oil Co (Indiana)). US Patent 4,210,545. 1 Jul 1980. Filed date 30 Mar 1979. vpp.

The oil-soluble product prepared by the process comprising, (A) dissolving in an organic solvent in molar ratios from about 0.1 to about 1.0 mole of thio-oxamide, from about 0.2 to about 2.0 moles of a saturated aliphatic aldehyde having from 1 to about 20 carbon atoms, and from about 0.2 mole to about 0 moles of an olefin hydrocarbon having at least 8 carbon atoms, (B) agitating the solution while cooling the same to a temperature of about 34° to 38°F., (C) adding to said colled solution from about 10 parts to about 20 parts by weight boron trifluoride etherate per 100 parts by weight of the solution of step (C). A lubricant composition comprising a major amount of a normally liquid lubricating oil, and from about 0.1% to about 10% of the oil-soluble reaction product prepared by the process of claim 1. An addition agent concentrate for lubricating oils, comprising a lubricating oil containing from about 10% to about 75% of the oil-soluble reaction product.

STORAGE

35981 (SAND—79-0732) **Interaction effects of storage caverns in salt.** Hilton, P.D.; Tillerson, J.R.; Benzley, S.E.; Gubbels, M.H. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

The US Strategic Petroleum Reserve program for crude oil stockpiling utilizes some existing solution mined caverns in Gulf Coast salt domes. Geomechanical analyses are impotant tools used to assess the structural stability of these caverns. This report addresses the ineractions between adjacent caverns which result from maintaining different pressures in the caverns. Finite element models of two adjacent caverns are analyzed for four different cavern spacings. The brine pressure is simulated in one cavern while the pressure in the adjacent cavern ranges from that of the oil head to atmospheric conditions. Stress distributions and deformed profiles of the caverns are plotted for the conditions simulated. Since the tensile strength of salt is low (typically 100 to 300 psi), regions in which tensile stresses occur are considered to have a significant probability of slabbing. A preliminary recommendation is made to maintain similar pressures to adjacent caverns in which the pillar thickness/cavern diameter ratio of the web between caverns is less than 0.5 unless cavern specific assessments indicate that the potential for pillar slabbing is minimal.

COMBUSTION

35982 (MIT—2295-80-1) **Flame luminosity and unburned hydrocarbon measurements in swirling combustion.** Giovanetti, A.J.; Hoult, D.P.; Keck, J.C.; Sarofim, A.F. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jul 1980. Contract AM01-76EI02295. 37p. NTIS, PC A03/MF A01.

The relationship between flame luminosity and unburned hydrocarbon concentration was studied using an atmospheric, tubular burner. Spectroscopic studies were conducted for different fuels, including kerosene, nitrogen-doped kerosene, and shale oil. Independent exhaust gas analyses were performed on shale oil and nitrogen-doped kerosene. At a particular fuel equivalence ratio, measurements showed flame luminosity to be a function of unburned hydrocarbons. Unburned hydrocarbons were found to become significant prior to an equivalence ratio corresponding to the flame's change from blue to yellow. This critical condition is a function of fuel-air mixing and inlet air preheat temperature. Spectroscopic work revealed presence of strong carbon, hydrocarbon, amine, and cyanide band spectra for the nitrogen-containing fuels. Exhaust gas analyses for shale oil and a comparable nitrogen-doped kerosene were similar.

NATURAL GAS

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 35940, 35941, 35943, 35947, 37123, 37130

35983 **Preliminary evaluation of various log analysis techniques for the eastern Devonian shales.** Curtis, J.B.; Fingleton, W.G. (Science Applications, Inc., Morgantown, WV). pp 20p, Paper I of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Although relatively complete well log suites have been recorded in wells drilled for characterization and stimulation research experiments, the Devonian shale is an unconventional gas resource and the reservoir is not readily evaluated by conventional well log analysis. Log suites recorded in empty and liquid-filled boreholes have been analyzed from a total of seven wells in three states in the Appalachian basin. Several techniques were attempted to identify gas- and kerogen-rich and naturally fractured intervals, including construction of resistivity and porosity overlays, calculation of Production Indices, and analysis of temperature, bulk density compensation and Sibilation curves. The information extracted from the logs was compared to conventional core desorption (offgas), fracture and geochemical data as well as to computer-generated synergetic logs. A suite of empty-borehole logs has been defined which will yield maximum formation evaluation information at a minimum cost to the operator.

35984 **Some considerations about the formation resistivity factor: porosity relations.** Sethi, D.K. (Dresser Industries, Inc., Houston, TX). pp 12p, Paper L of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The complexity of natural reservoir rocks precludes a mathematical treatment in developing a definite relation between the formation resistivity factor and porosity. Consequently, the main approach has been the empirical analysis of laboratory studies on samples or models of the different rock types by various investigators, who proposed numerous values for the coefficient a and exponent m in Archie's equation, F = axphi/sup -m/. The great variability of a and m values is a considerable source of error in assuming values for these parameters for the computation of water saturations from logs. At the same time, it is usually difficult and uneconomical to establish the values in each and every area by extensive laboratory work. A new variable m approach is found to be more useful in practice in the case of soft granular formations, for which the Humble Relation has received wide acceptance. The proposed relationship is statistically reasonable and gives very close values of the formation factor and, in some cases, even closer to the measured values on the samples analyzed by Winsauer, Shearin, Masson and Williams in the development of the Humble Relation.

35985 **Gas detection in the extremely shaly Bowdoin formation of Northern Montana.** Henry, K.C. (Schlumberger Well Services, Midland, TX). pp 9p, Paper T of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Improvements in drilling, completion, and stimulation techniques have increased the productivity of many shallow shaly-sand gas reservoirs. The Bowdoin formation in Northern Montana is a good example of this reservoir type. The depositional environment for the Bowdoin formation is placed in deep water in the Upper Cretaceous time period. In the producing interval, the formation consists of a series of thin laminated sandstones, silts, bentonitic shales, and clays. The entire interval can be over 200 feet thick. Core and log indications show the clay content to be near 50% in the producing interval. Since the shale content is so high, and the permeability consequently low, it becomes difficult to evaluate this formation by conventional methods. A resort to empirical methods is suggested. This paper reports the successful use of porosity-overlay methods to predict and achieve commerical-scale gas production in over fifty wells in the Bowdoin producing horizon. Sonic-neutron comparisons are used for gas detection, and sonic-density comparisons for determination of shale content. The information gained from these logs is also used to plan completions; a critical factor, since optimum stimulations are essential to profitable operations in formations like the Bowdoin.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 35960, 35961, 35962

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 37170

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 35974, 36753

35986 (DOE/EIA—0188/78) **United States imports and exports of natural gas 1978.** (Department of Energy, Washington, DC

(USA). Energy Information Administration). 8 Jun 1979. 12p. NTIS, PC A02/MF A01.

Tables are presented on the following items: summary of US pipeline imports and exports of natural gas; volume and cost of natural gas pipeline imports; volume and cost of natural gas pipeline exports; volume and cost of liquefied natural gas imports; and volume and cost of liquefied natural gas exports.

35987 (DOE/PE/70106—T3) **Regulation and deregulation of natural gas in the US: 1938-1985.** Merrill, P.R. (Harvard Univ., Cambridge, MA (USA). John Fitzgerald Kennedy School of Government). Jun 1980. Contract AM01-79PE70106. 104p. NTIS, PC A06/MF A01.

Public policy towards natural gas has swung first towards, and then away from regulation in this century. In 1906, the Congress specifically excluded natural gas from the jurisdiction of the Interstate Commerce Commission. Three decades later, a New Deal Congress passed the Natural Gas Act of 1938 bringing pipelines under the control of the Federal Power Commission (FDC). Forty years thereafter, the Congress passed a phased decontrol bill, the Natural Gas Policy Act (NGPA) of 1978, as part of the Carter Administration's National Energy Plan. Recently, the Congress has backed off from New Deal legislation in other markets - notably aviation and trucking. In this study, the rise and fall of economic regulation in the natural gas industry are examined to understand: (1) why public policy has followed a pendulum's path, and (2) the economic consequences of regulation and deregulation. The main part of the analysis is directed toward the Natural Gas Policy Act of 1978. Widely viewed as a deregulation measure, the author finds that the Act is more restrictive and burdensome than the pricing policies it superceded. The path toward deregulation in natural gas and perhaps other markets is not as direct or simple as might be expected.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 35976, 37170, 37178

ARTIFICIAL STIMULATION

REFER ALSO TO CITATION(S) 35959

35988 **Secondary recovery process .** Allen, J.; Tate, J. (to Texaco Inc). US Patent 4,210,205. 1 Jul 1980. Filed date 22 May 1978. vpp.

A description is given of a process for recovering hydrocarbons from a hydrocarbon-bearing formation containing acid-soluble components having at least one injection well and at least one production well penetrating the said formation and in fluid communication therewith, which comprises displacing through the formation a composition comprising an acidic aqueous polymer solution and recovering hydrocarbons through the production well, the said acidic aqueous polymer solution comprising a material selected from the group consisting of: (I) terpolymer a consisting of repeating units of: (II) terpolymer B consisting of repeating units of (III) terpolymer I or II alkoxylated with about 2 to about 100 weight percent of a substance selected from the groiup consisting of ethylene oxide and a mixture of ethylene oxide and propylene oxide wherein in the said mixture the weight percent of ethylene oxide ranges from about 60 to about 95, the said material being dissolved in an aqueous solution of a non-oxidizing mineral acid, wherein in terpolymer a the weight percent of vinylpyrrolidone units will vary from about 65 to about 80, the weight percent of vinyl acetate units from about 8 to about 15 with the balance being 2acrylamide-2-methylpropanesulfonic acid, wherein in terpolymer B the weight percent of vinylpyrrolidone units will vary from about 65 to about 80, the weight percent of hydroxyethyl acrylate units from about 8 to about 15 with the balance being 2-acrylamide-2-methylpropanesulfonic acid, wherein the said terpolymer is present in the said acidic aqueous polymer solution in a concentration of from about 1 to about 10 weight percent and wherein the number average molecular weight of the said terpolymer is from about 10,000 to about 2,000,000.

35989 **Prediction of well productivity from wireline logs, McAllen Ranch field.** Tootle, J.R. (Shell Oil Co., New Orleans, LA). pp 18p. Paper H of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Well productivity before and after fracture stimulation can be estimated using wireline log and petrophysical data. For the 10 wells in this study, an average of only 36% of reservoirs vertical thickness was stimulated by fracture treating. The computer can be used to evaluate Vicksburg wells. Permeability was found to be a function of porosity and grain size after correcting for fractured grains and interstitial fines. The relationship used was: $K = 4.49 \times 10^{-5} \times dm^2(e/sup -1.31\sigma/) \times phi^{2\ 284}$. The standard error of estimate is 0.94 millidarcies. With this relationship a commercial well required about 10 md-ft at current economic conditions and typical reservoir pressures.

LEGISLATION AND REGULATION

REFER ALSO TO CITATION(S) 35976

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 35977, 35978, 35986

35990 **Petroleum storage and transportation capacities. Volume VI. Gas pipeline.** Washington, DC; National Petroleum Council (1979). 149p.

The Gas Pipeline Task Group's report includes: gas flow data across state or regional boundaries, including flowing volumes and design capacities; list of underground storage fields by state, county, and field name and their daily and annual delivery capacities; information on major pipeline interconnections and their delivery capabilities; statistical data of pipeline facilities in terms of miles of transmission pipeline by diameter, miles of gathering pipeline by diameter and installed horsepower; discussion on possible future gas sources (e.g., LNG, SNG, and new supplies from Alaska and Mexico) and how they may be handled by the gas transmission network; discussion on the flexibility of the pipeline systems for peak day demand versus normal operational levels; and background information relating industry structure and operations. Tabulated detail information are found in the appendices.

PROPERTIES

REFER ALSO TO CITATION(S) 36555

STORAGE

REFER ALSO TO CITATION(S) 35990

OIL SHALES AND TAR SANDS

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 36012

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

35991 (FE—2346-63) **Outcrop descriptions of the Antrim shale.** Hathon, C.; Sibley, D.; Cambray, F.W. (Dow Chemical Co., Midland, MI (USA)). Apr 1980. Contract AC01-76ET12153. 13p. (DOW/SR—63). NTIS, PC A02/MF A01.

Samples of Michigan Basin Antrim shale were taken from each of the three locations where the shale is exposed at the surface in sufficient quantity to be studied. Detailed stratigraphic descriptions were prepared. Although there is considerable variation between individual beds, there are no unique units which can be used for lithological correlation.

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 37436

35992 (SAND—80-0857C) **Dynamic rock fragmentation: oil shale applications.** Boade, R.R.; Grady, D.E.; Kipp, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-801052—1). NTIS, PC A02/MF A01.

From Society for Experimental Stress Analysis meeting; Ft Lauderdale, FL, USA (12 Oct 1980).

Explosive rock fragmentation techniques used in many resource recovery operations have in the past relied heavily upon traditions of field experience for their design. As these resources,

notably energy resources, become less accessible, it becomes increasingly important that fragmentation techniques be optimized and that methods be developed to effectively evaluate new or modified explosive deployment schemes. Computational procedures have significant potential in these areas, but practical applications must be preceded by a thorough understanding of the rock fracture phenomenon and the development of physically sound computational models. This paper presents some of the important features of a rock fragmentation model that was developed as part of a program directed at the preparation of subterranean beds for in situ processing of oil shale. The model, which has been implemented in a two-dimensional Lagrangian wavecode, employs a continuum damage concept to quantify the degree of fracturing and takes into account experimental observations that fracture strength and fragment dimensions depend on tensile strain rates. The basic premises of the model are considered in the paper as well as some comparisons between calculated results and observations from blasting experiments.

35993 Method of detonating explosives for fragmenting oil shale formation toward a vertical free face . Hutchins, N.; Ridley, R. (to Occidental Oil Shale Inc). US Patent 4,210,366. 1 Jul 1980. Filed date 13 Nov 1978. vpp.

A description is given of a method for explosively expanding oil shale formation toward a limited void volume provided by a void excavated in a retort site in formation containing oil shale, wherein said void has at least one vertical free face, the improvement comprising the steps of: placing explosive in a row of blasting holes in a remaining portion of unfragmented formation within the retort site adjacent such a vertical free face, said blasting holes being mutually spaced apart along the length of the void; and detonating explosive in the blasting holes in a single round in a time delay sequence progressing along the length of the row of blasting holes for explosivelyexpanding formation in said remaining portion of unfragmented formation toward such vertical free face for forming at least a portion of a fragmented permeable mass of formation particles containing oil shale in an in situ oil shale retort.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 36006, 36621

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 35892, 35993, 36013

35994 (FE—2346-73) Energy from true in situ processing of Antrim Shale: extraction trials in an explosively fractured site. VanDerPloeg, M.L.; Peil, C.A.; Kinkel, C.G.; Pihlaja, R.K.; Murdick, D.A.; Frost, J.R.; Lund, M.M. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Aug 1980. Contract AC01-76ET12153. 135p. NTIS, PC A07/MF A01.

Three in situ energy extraction trials were conducted at The Dow Chemical Company's oil shale site, in Michigan's Sanilac County, near the town of Peck. Here the Antrim shale layer occurs between 1200 and 1400 feet underground. The trials began on October 14, 1979, and ended on April 1, 1980. The three trials, lasting 7, 60 and 17 days respectively, were conducted in a formation prepared by explosive fracturing. Ignition energy was generated with a methane burner. Some energy in the form of a dilute fuel gas (5 to 50 btu/scf) was recovered in each trial but upon ignition drastic decreases in flow communication occurred between injection and production wells. That problem prevented the planned exploration of techniques which would raise the energy value of the production gas. Upon cool down of the formation after each trial, air permeability tests showed inter-well communication levels returning to near preburn levels. Thermal expansion is the most likely cause of the reduced permeability experienced under retorting conditions.

35995 (FE—2346-75) Energy from true in situ processing of Antrim shale: sampling and analytical systems. Pihlaja, R.K. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Aug 1980. Contract AC01-76ET12153. 106p. NTIS, PC A06/MF A01.

Reliable on-line analysis of production gas composition is fundamental to the success of an in situ extraction experiment in Antrim shale. An automated sampling and analysis system designed to meet this need has provided high quality analytical data for three extraction trials without a single day when no data were taken. The production gas samples were routinely analyzed by both gas chromatography (GC) and a bank of continuous on-line process gas analyzers. The GC's analyzed for H_2, O_2 + Ar, N_2, CO, CO_2, SO_2, H_2S, individual C_1 - C_5 hydrocarbon species, and lumped C_6 + hydrocarbon species, each analysis requiring up to an hour to run. The process gas analyzers measured CO, CO_2, total hydrocarbons (% vol CH_4 equivalent), and O_2 continuously. The process gas analyzers were shown to be especially well suited for this application because of their fast response. The GC data provided itemized composition details as well as an independent check of process analyzer data. Sample selection, data collection and processing from both the GC's and process gas analyzers was handled by a Perkin Elmer Sigma-10 minicomputer. The combination of the two analytical techniques and automated data handling yielded a versatile and powerful system. The production gas sampling system demonstrated the feasibility of transmitting a properly treated gas sample through a long (1000 ft) 1/8" diameter sample line. The small bore tubing allowed the analytical instruments to be located a safe distance away from the well heads and yet maintain a reasonably short sample transport lag time without handling large volumes of gas.

35996 (FE—2346-76) Energy from true in-situ processing of Antrim shale: methane burner ignition system. VanDerPloeg, M.L.; Pihlaja, R.K. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Aug 1980. Contract AC01-76ET12153. 34p. NTIS, PC A03/MF A01.

A rugged yet simple burner that can be easily ignited and reignited is a necessity if in situ thermal methods of energy extraction are to be feasible. During extraction trials at the Dow Chemical Company's oil shale site at Peck, Michigan such a burner was utilized. The performance of the TOR Development burner and ignitor system proved to be reliable and practical under field conditions. However, some recently discovered measures are crucial in protecting the burner and associated downhole hardware. With such precautions burner life was extended by a factor of 15. In the first trial burner life was two days and in the second trial the burner remained intact at least thirty days. Also described is a system which monitored burner performance by continuously analyzing burner exhaust gases. A slip stream sampling technique utilized the high well pressure to transport, at nearly Mach I, a sample of burner exhaust gas to the analytical trailer. There the sample was analyzed for CO, CO_2, unburned hydrocarbons, and O_2 by a bank of high speed process gas analyzers. Burner flameouts could be detected in less than 2 minutes. Also the system allowed burner (air/fuel) ratios to be determined on a real time basis. These ratios were used for (1) setting the proper air-fuel mixtures for ignition and steady state operation, (2) leak detection, (3) estimation of burner deterioration after extended use, and (4) study of the burner's steady state and transient response characteristics.

35997 (FE—2346-87) Development of an induced fracture model for Antrim shale. Carmi, S. (Dow Chemical Co., Midland, MI (USA); Wayne State Univ., Detroit, MI (USA)). Aug 1980. Contract AC01-76ET12153. 41p. NTIS, PC A03/MF A01.

The main goal of our investigation was to develop a structural response model which simulates the in-situ fracturing of Antrim oil shale for the purpose of enhancing permeability and thus allow partial combustion for the subsequent retorting and recovery of petroleum products. We strictly adhered to our goal and developed a model, which through a number of stages, is capable of predicting the change in rock permeability for a given explosive load and existing in-situ conditions such as rock material properties and overburden pressure. Our computer model uses as a first step a finite element package which we developed for calculating the induced stress field due to the explosion. This stage is followed by a rock-failure and crack analysis of the individual elements and joints which culminates in the final state which is the rock permeability assessment. Our results are presented as computer program listings, graphic representations of the finite element mesh and figures which graphically display our findings. The result relating to the differential permeability penetration, namely the preferred vertical rather than the horizontal direction, is noteworthy and of particular practical interest.

35998 (FE—2346-92) Seismic investigations of antrim shale fracturing-ground motion studies. Turpening, R.M.; Frolich, C. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). Sep 1980. Contract AC01-76ET12153. 18p. NTIS, PC A02/MF A01.

The Dow Chemical Company contract with the Department of Energy to investigate the feasiblity of recovering energy from Antrim shale by an in situ process required the investigation of several fracturing techniques. One of these included the use of explosives detonated in wellbores at a depth of 1200 to 1400 feet. This report summarizes the seismic monitoring of several of these explosions and the analysis of the data obtained.

35999 Induction coil method for detecting underground flame fronts. Ginsburgh, I.; Mccollum, J. (to Standard Oil Co (Indiana)). US Patent 4,210,867. 1 Jul 1980. Filed date 17 Jul 1978. vpp.

In the in situ combustion of a subterranean carbaneceous stratum, a method is given for detecting an underground flame front comprising (A) providing at least one stationary multi-turn coil of wire on the surface of the ground electrically connected into one or more circuits in which an electrical resonance condition is established; (B) continuously monitoring the change in impedance characteristics in one or more of said circuits as the combustion progresses

and providing an indication of the location, speed, and vertical and lateral movement of said flame front in response to said monitored change in impedance characteristic.

36000 Method for detecting an underground flame front using resistance probes . Ginsburgh, I.; Mc C. (to Standard Oil Co (Indiana)). US Patent 4,210,868. 1 Jul 1980. Filed date 17 Jul 1978. vpp.

In the in situ combustion of a subterranean carbonaceous stratum, a method is given for detecting the flame front comprising (A) providing two or more stationary probes inserted into the ground electrically connected in one or more circuits capable of measuring the resistance between pairs of probes, (B) monitoring the change in resistance between two or more stationary probes during the combustion in one or more of said circuits and providing an indication of the location, pattern and orientation of said flame front in response to said monitored change in resistance.

REFINING

REFER ALSO TO CITATION(S) 35888

36001 (NP—25005, pp 23p, Paper 25) **Energy alternatives: synthetic fuels and combustion.** Sharma, S.P. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The need for the development of a synthetic fuels industry is related. Hydrogen requirements in the conversion of oil shales and coal to synthetic fuels are high and add considerably to the cost. Problems involved in the burning of low hydrogen-to-carbon ratio fuels are described. There is a need for research in the field of soot formation and burnout for complex systems. (DMC)

PURIFICATION

REFER ALSO TO CITATION(S) 35973

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 35995, 36001, 36046, 36971

36002 (CONF-800680—5) **Sample management and chemical characterization of the Paraho/Sohio/US Navy crude and refined shale oil suite.** Griest, W.H.; Guerin, M.R.; Yeatts, L.B. Jr.; Clark, B.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

From Symposium on health effects investigations of oil shale development; Gatlinburg, TN, USA (23 Jun 1980).

The role of the EPA/DOE Fossil Fuels Research Materials Facility in this study is to actively support and coordinate the health effects investigations of this oil shale development by acting as a central point for acquisition, cataloging, storage, and distribution of referenceable materials for study. In addition, selected materials are chemically fractionated for bioassay and are characterized in additional detail beyond that of routine stability monitoring. Finally, the Facility is acting as an information transfer agent to insure that the results of the investigations are made available to the oil shale industry and the funding agencies. This paper is concerned with the sample management and characterization aspect of the Facility's role in this study.

36003 (DOE/LETC/RI—80/12) **Characterization of nitrogen compound types in hydrotreated Paraho shale oil.** Holmes, S.A.; Latham, D.R. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Oct 1980. 38p. NTIS, PC A03/MF A01.

Results from the separation and characterization of nitrogen compound types in hydrotreated Paraho shale oil samples were obtained. Two samples of Paraho shale oil were hydrotreated by Chevron Research Company such that one sample contained about 0.05 wt. percent nitrogen and the other sample contained about 0.10 wt. percent nitrogen. A separation method concentrate specific nitrogen compound types was developed. Characterization of the nitrogen types was accomplished by infrared spectroscopy, mass spectrometry, potentiometric titration, and elemental analysis. The distribution of nitrogen compound types in both samples and in the Paraho crude shale oil is compared.

36004 (FE—2346-83) **Fischer assay analyses of the Antrim Oil Shale of the Michigan Basin.** Leffert, C.B.; Schroeder, R.R. (Wayne State Univ., Detroit, MI (USA)). Aug 1980. Contract AC01-76ET12153. 164p. NTIS, PC A08/MF A01.

Modified Fischer Assays were run and are reported on 841 samples of Antrim Oil Shale. These samples were taken from 31 wells and 9 outcrop locations throughout the Michigan Basin. Yields in both weight percent of oil, water, spent shale, gas plus loss and in gal/ton of oil and water and oil specific gravity are tabulated. Procedures, apparatus and instrumentation adapted for this work were shown by comparison tests and by repetitive assays to be accurate and precise. Data recording, calculations, data storage and plotting were all done using computer programs, files and tapes. The oil yield in gal/ton of shale is plotted versus drillers depth in feet for each of the 31 wells and for three cross sections across the Michigan Basin. The average oil yields for these three cross sections were: Northern, 4.78 gal/ton; Central, 4.49 gal/ton; and Southern, 4.64 gal/ton. The average oil yield was 4.67 gal/ton. Probability density curves resembled a Gaussian-type distribution with an added spike of near-zero yield material which was attributed to a small amount of sampling above and below the Antrim formation and the intrusion of some noncarbonaceous material into the Antrim in some locations. The density function for the entire formation showed fractional yields of oil of only 20% > 7.0 gal/ton, 15% > 8.0 gal/ton and 5.0% > 11 gal/ton. The average oil yield represents for an estimated 44,500 square miles of the Michigan Basin the potential of 2.8 trillion barrels of Fischer Assay extractable oil.

36005 (FE—2346-85) **Physical properties of Michigan Antrim Shale.** Hockings, W.A. (Michigan Technological Univ., Houghton (USA). Inst. of Mineral Research). Aug 1980. Contract AC01-76ET12153. 139p. NTIS, PC A07/MF A01.

The physical properties of approximately 225 core samples and 700 samples of well cuttings from the Antrim Shale formation in the Michigan Basin were measured. The properties included density, porosity, permeability, pore size distribution, specific surface, and thermal expansion. Measurements were made before and after roasting in air and in nitrogen. In general the properties showed little variation with depth or location within the sampling area. The average porosity was about 8 percent of which approximately one-half consisted of closed pores. The porosity increased by about a factor of two after roasting at 500°C. The permeability was found to be very low, averaging about 0.008 millidarcies. Permeability was higher in the direction parallel to the bedding planes than in the direction perpendicular to the planes. After roasting at 500°C the permeability increased by about a factor of ten. Measurements while heating from 20 to 225°C showed only minor variations in permeability with temperature. The specific surface area of the shale is low, averaging about 0.5 square meters per gram. The pore size distribution is bimodal with most of the pore volume in the size ranges of 0.01 to 0.1 and 10 to 100 micrometers. The shale expands about one percent perpendicular to bedding and 0.2 percent parallel to bedding when heated to 500°C. The average expansion coefficient is 0.0025 percent per °C on heating and 0.0010 on cooling. Peaks in the heating curve occur at about 25°C and 450°C.

36006 (UCRL—84066) **H_2S evolution from Colorado oil shale.** Burnham, A.K.; Bey, N.K.; Koskinas, G.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Aug 1980. Contract W-7405-ENG-48. 36p. (CONF-800977—1). NTIS, PC A03/MF A01.

From ACS symposium series on oil shale, tar sands, and related materials; Pittsburgh, PA, USA (30 Sep 1980).

Most of the sulfur in oil shale occurs in pyrite and a smaller amount is contained in the kerogen. It is demonstrated that the major source of H_2S during oil shale pyrolysis is from the reaction of pyrite with organic matter. Results are presented for the evolution of H_2S from Colorado oil shale heated at 5°C/min under autogenous (self-generated), argon, steam, and hydrogen atmospheres at atmospheric pressure. In an autogenous atmosphere, most of the H_2S is evolved between 400 and 500°C. Addition of finely ground pyrite increases the amount but does not change the evolution profile of H_2S. In an argon atmosphere, however, added pyrite causes a substantial increase in H_2S evolution only between 475 and 525°C. Similar reaction characteristics were observed with large-grained natural pyrite in a Tract C-a oil shale. These results also demonstrate the importance of intimate contact between the pyrite and organic material. In a steam atmosphere, pyrite is oxidized to iron oxides and the H_2S evolution increases substantially. In some samples, essentially all the initial sulfur is evolved as H_2S at temperatures below 800°C. Finally, we discuss the thermodynamic limitations on the observed reactions under retort conditions.

DIRECT USES AND BY-PRODUCTS

36007 Determination of benzo[a]pyrene in shale oil by solid-surface fluorescence. Hurtubise, R.J. (Univ. of Wyoming, Laramie); Skar, G.T.; Poulson, R.E. *Anal. Chim. Acta;* **97**: 13-19(1978).

A method has been developed for determining benzo[a]pyrene in shale oil by combining dry-column chromatography, thin-layer chromatography and fluorescence spectrometry. A two-step separation method was employed to isolate benzo[a]pyrene from shale oil. Benzo[a]pyrene was identified and determined by detecting its fluorescence directly from chromatoplates; as little as 0.06 ng can be detected. The limit of detection of

benzo[a]pyrene in shale oil is ca. 1.2 ppM and the reproducibility of the method is +- 2.6 ppM. 2 tables.

HEALTH AND SAFETY

36008 (LA—8459-MS) **Paraho oil shale workers occupational health study.** Rudnick, J.; Garcia, L.L.; Voelz, G.L.; Schulte, H.F. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01.

An occupational health and industrial hygiene study of the oil shale workers at the Department of Energy Anvil Points Oil Shale Mine and Retorting Facility near Rifle, Colorado, was conducted. This evaluation was to look specifically at the potential occupational health problems associated with the Paraho direct combustion retorting process. In addition, the mine, crushing plant, disposal, and auxiliary operations were also studied. Industrial hygiene data did not confirm any personal exposures in excess of industrial hygiene standards. However, area sampling did show that areas and operations would present significant exposures to some employees should such employees work full time in these areas. Commercial scale operations will require industrial hygiene control measures. The medical study performed on the Paraho employees indicates that there are no health problems or effects positively correlated with exposure to oil shale operations or its retorting products. The major health effect noted was from job-incurred injuries. Commercial scale operations will require periodic comprehensive medical evaluations as well as design of operations and equipment to avoid potential health and safety problems.

MARKETING AND ECONOMICS

36009 **Time-economics of developing low-grade petroleum deposits: as exemplified by the Athabasca Tar Sands of Alberta, Canada.** Dawson-Grove, G.E.; . (Petrophysical Consultants International Ltd., Calgary, Canada). pp 6p, Paper NN of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

After a brief description of the geography and geology of the Tar Sands, and of the economics of extracting oil from them, the time factor, which is the main thesis of this paper, is presented and discussed. The total amount of oil which can be extracted from the Athabasca Tar Sands of Alberta, and hence the length of time for which Canada can enjoy production from them, will depend on how much we are willing to pay for it. The same argument can be applied to the trillions of barrels of heavy oil and quadrillions of cubic feet of tight sand gas already proven to be in deposits throughout North and South America, and no doubt occurring also all over the world. There is enough oil to last us all for hundreds of years - if we are willing to pay for it.

WASTE RESEARCH AND MANAGEMENT

36010 **Inorganic sulfur species in waste waters from in situ oil shale processing.** Stuber, H.A. (Geological Survey, Denver, CO); Leenheer, J.A.; Farrier, D.S. *J. Environ. Sci. Health, Part A;* **13**: No. 9, 663-675(1978).

This sulfate and thiocyanate were found to be important solutes in four waste waters derived from combustion type in situ processing of oil shale. Thiosulfate, thiocyanate, tetrathionate, sulfite, sulfate and total sulfur concentrations determined, and the predominant sulfur species in all waste-water samples was thiosulfate, ranging from 420 to 2200 mg/L. Thiocyanate levels ranged from 24 to 730 mg/L. Hydrogen sulfide has been reported in gases derived from the retorting of oil shale, but sulfide was not detected in any of the waters studied. Analysis of water associated with an in situ reto t one year after oil production has shown that thiocyanate can persist in ground waters remaining in retorted zones. Some similarities in the composition of wastes from the in situ retorting of oil shale and the ammoniacal liquors produced during coking of coal are noted. 2 tables.

36011 **Effect of an in situ-produced oil shale processing water on metabolism.** Nelson, K.F.; North, D.S.; Payne, G.R.; Anderson, A.D.; Poulson, R.E.; Farrier, D.S. (Univ. of Wyoming, Laramie). *Arch. Environ. Contam. Toxicol.;* **7**: 273-281(1978).

The effects of in situ-produced oil shale retort water on the metabolism of various substrates was studied both in vivo and in vitro. The induction observed in rats was classified as Type I due to an increase in metabolism of hexobarbital and ethylmorphine without subsequent increases in zoxazolamine metabolism. The maximal absorption of the cytochrome-P-450-CO complex was observed to be 450 mμ, also consistent with Type I inducers. Cytochrome P-450 levels were also significantly increased over controls.

ENVIROMENTAL ASPECTS

36012 (DOE/EIS—0068) **Draft Programmatic Environmental Impact Statement: development policy options, Naval Oil Shale Reserves, Garfield County, Colorado.** (Department of Energy, Washington, DC (USA)). Sep 1980. 385p. NTIS, PC A17/MF A01.

This programmatic statement deals with several levels of potential decisions which can lead to DOE action to develop the oil shale resources of its 35,000-acre Naval Oil Shale Reserves in Northwest Colorado. These decisions may become imminent due to the need to meet the President's 1990 domestic goal of 4.5 million additional barrels of liquid fuels produced or conserved. This is a candidate site for a contingency oil shale development venture. This means that under current DOE policy the Reserve is likely to be opened to development only if there are significant delays and shortfalls in private industry's effort to launch commercial-scale facilities in the area. It compares the environmental impacts from the range of potential production from this Reserve (50 to 200 thousand barrels per day) with impacts from additional development of other liquid fuel options which might have to provide an equivalent amount of shale oil by 1990. These options include coal liquefaction, biomass, and increased conservation. Second, this EIS presents an environmental and financial impact analysis relating five generalized development ventures ranging from a low to a high level of government funding and participation. Developing the Naval Oil Shale Reserves in Colorado to commercial-scale production of 50,000 barrels per day is estimated to have the following gross impacts: alteration of 3% of the total Reserve land; annual consumption of 4624 to 17,500 acre feet of water, depending on process chosen; yearly emissions of 361 tons of SO_2, 3641 tons of NO/sub x/, 656 tons of CO, 951 tons of particulate, 262 tons of HC; and increasing the area population by a total of 7500 people. A specific project EIS, which would discuss environmental impacts in detail, would precede any development action by DOE.

36013 (FE—2346-78) **Environmental monitoring and analysis in support of Antrim oil shale research. Final report, March 1977-July 1980.** Thomas, G.S.; Tanis, F.J. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). Jul 1980. Contract AC01-76ET12153. 152p. NTIS, PC A08/MF A01.

Environmental monitoring was conducted to document impacts from an in situ Antrim oil shale experiment. Monitoring took place over a nearly three and one-half year period. Parameters monitored included air quality, water quality (surface and subsurface), site vegetation, surface disruptions, soils, noise, surface elevation and impacts to neighboring residents. Three interim reports were generated which contain a great deal of the baseline data for the environmental monitoring program. They have the same title as this final report and have report numbers FE-2346-28, FE-2346-46, and FE-2346-56. No significant environmental impacts were observed other than physical disruption of the land surface. The presence of chloride in the site pond due to previous operations was noted.

NUCLEAR FUELS

RESERVES

REFER ALSO TO CITATION(S) 36046

36014 (CONF-800943—(Summ.), pp 4-5) **Uranium Resources.** Patterson, J.A. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36015 (LA—8479-PR) **Oklo: natural fission reactor program. Progress report, January 1-March 31, 1980.** Norris, A.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36;AC06-76RL01830. 15p. (ONWI/Sub—80/E511-01100-5). NTIS, PC A02/MF A01.

The techniques to measure lead isotopic abundances in geologic material have been refined and tested with National Bureau of Standards lead isotope standards. The results from 28 analyses show that our measurements of $^{207}Pb/^{206}Pb$ and $^{208}Pb/^{206}Pb$ ratios are both reproducible and accurate. However, our data for the $^{204}Pb/^{206}Pb$ ratio indicate that our mass 204 background correction may be causing problems. The initial work to measure gadolinium isotopic abundances has been accomplished. Studies of rubidium and strontium isotopic ratios in the Oklo reactor zone 2 and adjacent areas indicate that fissiogenic rubidium and strontium are observed in

solution when the samples adjacent to the reactor zone are leached for 20 minutes with 0.5 N HCl, while fissiogenic rubidium and strontium are observed in the insoluble residues of samples from reactor zone 2 that are leached in the same manner. Additional work will be done to see if some quantitative conclusions about rubidium and strontium transport at the Oklo site can be deduced.

36016 (LA—8508-PR) **Geostatistics project of the national uranium resource evaluation program. Progress report, October 1979-March 1980.** Campbell, K.; Bement, T.R.; Howell, J.A.; Beckman, R.J.; Jackson, K.; Buslee, P. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 50p. NTIS, PC A03/MF A01.

During the period covered by this report, the authors investigated the serial properties of aerial radiometric data. Results were applied to the choice of minimum segment width in the maximum variance segments algorithm and to the use of aerial radiometric data in the design of ground sampling experiments. The report also presents the results of a comparison of normal and lognormal percentile estimation techniques. Twenty-two quadrangles are being analyzed in the search for a uranium favorability index. Computer codes developed during this investigation have been provided to the Bendix Field Engineering Corporation in Grand Junction, Colorado.

36017 (ORNL/EIS—121/V4) **Geological and geochemical aspects of uranium deposits: a selected, annotated bibliography.** Thomas, J.M.; Garland, P.A.; White, M.B.; Daniel, E.W. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 209p. NTIS, PC A10/MF A01.

This bibliography, a compilation of 474 references, is the fourth in a series compiled from the National Uranium Resource Evaluation (NURE) Bibliographic Data Base. This data base was created for the Grand Junction Office of the Department of Energy's National Uranium Resource Evaluation Project by the Ecological Sciences Information Center, Oak Ridge National Laboratory. The references in the bibliography are arranged by subject category: (1) geochemistry, (2) exploration, (3) mineralogy, (4) genesis of deposits, (5) geology of deposits, (6) uranium industry, (7) geology of potential uranium-bearing areas, and (8) reserves and resources. The references are indexed by author, geographic location, quadrangle name, geoformational feature, and keyword.

EXPLORATION

REFER ALSO TO CITATION(S) 36017, 36972

36018 (CONF-800943—(Summ.), pp 132-134) **Slurry calcination process for conversion of aqueous uranium and plutonium to a mixed-oxide powder.** Jones, M.K.; Jenkins, W.J. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36019 (GJBX—171(80)) **Klamath falls 1° x 2° NTMS area: Oregon. Data report.** Koller, G.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1980. Contract AC13-76GJ01664. 18p. (DPST—80-146-6). NTIS, PC E02/MF $3.50.

Surface sediment samples were collected at 1413 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 150 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements from sites where water was available (pH, conductivity, and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th and U/Hf ratios; and scintillometer readings at sediment sample sites are included. Uranium concentrations in sediments of the Klamath Falls quadrangle are relatively low, with a maximum value of 17 ppM. Highest values occur in tertiary volcanic rocks in the uranium-producing area near the town of Lakeview and in Quaternary volcanics in the north-central part of the quadrangle.

36020 (GJBX—172(80)) **Price 1° x 2° NTMS area, Utah. Data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13-76GJ01664. 16p. (DPST—80-146-9). NTIS, PC E02/MF $3.50.

Surface sediment samples were collected at 1444 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 137 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, U/(Th + Hf), and U/La ratios; and scintillometer readings at sediment sample sites are included. Uranium concentrations in sediments of the Price quadrangle are relatively low, with a maximum value of 14.7 ppM. The mean of the logs of uranium values in sediments is 0.38, which corresponds to a value of about 2.4 ppM. Many of the lowest uranium concentrations occur in the northern part of the San Raphael Swell, in the southeastern portion of the quadrangle. Ground water sampling sites are too widely dispersed to allow preliminary interpretation.

36021 (GJBX—173(80)) **McDermitt 1° x 2° NTMS area, Nevada. Data report (abbreviated).** Thayer, P.A.; Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13-76GJ01664. 18p. (DPST—80-146-10). NTIS, PC E02/MF #3.50.

Surface sediment samples were collected at 1337 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 255 sites and surface water samples were collected at 41 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water and surface water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Data from ground water and surface water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). He analyses are given for ground water. Data from sediment sites include (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, U/(Th + Hf), and U/La ratios; and scintillometer readings at sediment sample sites are included. Uranium concentrations in sediments of the McDermitt quadrangle are relatively low, with a maximum value of 20.5 ppM. The mean of the logs of uranium values in sediments is 0.56, which corresponds to a value of about 3.6 ppM. Many of the highest uranium values occur in the Santa Rosa Range and in the Bull Run and Tuscarora Mountains. Most of the higher uranium values occur in areas underlain by tertiary-age granitic intrusive rocks and Tertiary felsic volcanic rocks. Ground water and stream water samples are too widely dispersed to allow for preliminary interpretation.

36022 (GJBX—174(80)) **Wells 1° x 2° NTMS area, Nevada. Data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13-76GJ01664. 18p. (DPST—80-146-11). NTIS, PC E02/MF $3.50.

Surface sediment samples were collected at 1336 sites, at a target sampling density of one site per 13 square kilometers. Ground water samples were collected at 112 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water and surface water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Data from ground water and surface water sites include (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements where applicable (water temperature, well description, and scintillometer reading), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Helium analyses are given for ground water. Data from sediment sites include (1) stream water chemistry measurements from sites where water was available, and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Areal distribution maps, histograms, and cumulative frequency plots for

most elements; U/Th, U/Hf, U/(Th + Hf), and U/La ratios; and scintillometer readings at sediment sample sites are included.

36023 (GJBX—175(80)) **Stream sediment detailed geochemical survey for Marysvale, Utah.** Butz, T.R.; Vreeland, J.L.; Bard, C.S.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1980. Contract AC13-76GJ01664. 188p. (K/UR—42). NTIS, PC E05/MF $3.50.

Results of the Marysvale detailed geochemical survey are reported. Field and laboratory data are presented for 397 stream sediment samples and 160 radiometric readings. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Stream sediments containing significant amounts of soluble uranium (≧ 16.93 ppM) occur in numerous areas, the most prevalent being in the western portion of the survey area, within and surrounding the Mount Belknap Caldera. Thorium, berylllium, cerium, manganese, molybdenum, niobium, potassium, yttrium, zinc, and zirconium occur in concentrations ≧ 84th percentile in many sediment samples taken from within and surrounding the Mount Belknap Caldera. The uranium and related variables are associated with highly silicic intrusions and extrusions of the Mount Belknap Volcanics, as well as hydrothermal activity which has occurred in the Marysvale volcanic field.

36024 (GJBX—176(80)) **Uranium hydrogeochemical and stream sediment reconnaissance data release for the Elk City NTMS Quadrangle, Idaho/Montana, including concentrations of forty-five additional elements.** Broxton, D.E.; Beyth, M. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract AC13-76GJ01664. 293p. (LA—8012-MS). NTIS, PC A13/MF A01.

Totals of 1580 water and 1720 sediment samples were collected from 1754 locations in the quadrangle. Elemental concentration, field measurement, weather, geologic, and geographic data for each sample location are listed for waters in Appendix I-A and for sediments in Appendix I-B. Uranium/thorium ratios for sediment samples are also included in Appendix I-B. All elemental analyses were performed at the LASL. Water samples were initially analyzed for uranium by fluorometry. All water samples containing more than 40 parts per billion (ppB) uranium were reanalyzed by delayed-neutron counting (DNC). A supplemental report containing the multielement analyses of water samples will be open filed in the near future. Sediments were analyzed for uranium and thorium as well as aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, nickel, niobium, potassium, rubidium, samarium, selenium, scandium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, zinc, and zirconium. Basic statistics for 40 of these elements are presented. All sediments were analyzed for uranium by delayed-neutron counting. Other elemental concentrations in sediments were determined by neutron-activation analysis for 30 elements, by x-ray fluorescence for 12 elements, and by arc-source emission spectrography for 2 elements. Analytical results for sediments are reported as parts per million.

36025 (GJBX—180(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Natchez quadrangle of, of Mississippi and Louisiana. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Jul 1980. Contract AC13-76GJ01664. 322p. NTIS, PC E08/MF $3.95.

The Natchez quadrangle covers a region within and adjacent to the Mississippi River flood plain in the northern Gulf Coastal Physiographic Province. The underlying Mesozoic and Cenozoic sediments of the Mississippi Embayment are extremely thick and contain many piercement structures. Exposed sediments consist largely of recent alluvium in the flood plain area, and Cenozoic sediments of marine and nonmarine origin in adjacent areas. A search of available literature revealed no known uranium deposits in the area. Eighty-three uranium anomalies were found, using the selection criteria set forth in Appendix A, and are discussed briefly. None were considered significant, and most appeared to be of cultural origin. Magnetic data suggests extremely deep sources, and some possible structural complexity in the source area.

36026 (GJBX—181(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida survey, West Point quadrangle of, Mississippi and Alabama. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Aug 1980. Contract AC13-76GJ01664. 360p. NTIS, PC E09/MF $4.10.

The West Point Quadrangle of Mississippi and Alabama lies at the northeastern end of the Gulf Coastal Province. Tertiary and Cretaceous strata dominate surficial exposures. Some Paleozoic rocks are exposed in the extreme northeast. Examination of available literature shows no known uranium deposits in the area. Seventy-five groups of uranium samples were defined as anomalies and are discussed briefly. None were considered significant, and most were thought to be the result of cultural or weather effects. Magnetic data appeared to agree with the latest structural interpretations in the area, though the Ouachita Tectonic Belt was not visible defined by the magnetics.

36027 (GJBX—182(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, El Dorado quadrangle, Louisiana and Arkansas. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Aug 1980. Contract AC13-76GJ01664. 352p. NTIS, PC E09/MF $3.95.

The El Dorado quadrangle lies south of the Ouachita Mountains in the Gulf Coastal Province. Underlying Mesozoic sediments are relatively thick in the north, but thin considerably over the tops of the Sabine and Monroe Uplifts. Exposed sediments are largely Mesozoic in the north, and Cenozoic over the uplifted areas. A search of available literature revealed no known uranium deposits in this area. The concentrations of uranium in this quadrangle are extremely low. Seventy-six uranium anomalies were detected and are discussed briefly. None had any significance, and all appeared to have cultural origins. Magnetic data appears to be in agreement with existing structural interpretations of the region.

36028 (GJBX—183(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Greenwood quadrangle of Mississippi, Arkansas and Louisiana. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Aug 1980. Contract AC13-76GJ01664. 312p. NTIS, PC E07/MF $4.10.

The Greenwood quadrangle covers a region largely within the Mississippi River flood plain in the extreme northern Gulf Coastal Province. Tertiary sediments in this area are relatively thick, and overlie a Mesozoic section gradually shoaling to the north. The Ouachita Tectonic Zone strikes southeasterly through the center of the quadrangle. The exposed sequence is almost entirely Recent alluvium of the flood plain area. Older Cenozoic deposits crop out in upland areas on both sides of the river valley. A search of available literature revealed no known uranium deposits. Ninety-three uranium anomalies were detected and are discussed briefly. None were considered significant, and all appeared to occur as the result of cultural and/or weather effects. Magnetic data appear to be in agreement with existing structural interpretations of the region.

36029 (GJBX—184(80)) **Hydrogeochemical and stream sediment detailed geochemical survey for Sonora Pass, California.** Butz, T.R.; French, J.H.; Bard, C.S.; Leimer, H.W.; Helgerson, R.N.; Grimes, J.G.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1980. Contract W-7405-ENG-26. 408p. (K/UR—41). NTIS, PC E09/MF $3.50.

Results of the Sonora Pass, California, detailed geochemical survey are reported. Field and laboratory data are reported for 15 groundwater and 701 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are brieflty discussed. Analysis showed concentrations of uranium up to 38 ppB. High uranium values in groundwater producing from Mesozoic granitic rocks are associated with high values for sulfate, calcium, magnesium, manganese, strontium, and the sodium-chloride ratio. High uranium values in water derived from Miocene volcanic rocks are associated with anomalous amounts of sulfate, arsenic, cobalt, and zinc. Anomalous uranium values in stream sediment occur in a northeast-southwest trending zone in the central portion of the survey area, in the northwestern portion of the survey area, downstream from the Juniper uranium mine, and elsewhere in small areal trends. Anomalous thorium concentrations follow a somewhat different trend, with values ≧ 41 ppM occurring primarily in the northeastern section of the survey area. High U-FL, Un-NT, thorium, lithium, cerium, and yttrium values are found in sediment derived from granitic rocks; high values for scandium, strontium, barium, calcium, and cobalt are found in sediment derived from Miocene volcanic rocks; and high copper, nickel, zirconium, arsenic, and chromium values are found in Pliocene volcanic rocks. An overlay of ≧ 84th percentile areal plots of U-FL, U-NT, strontium, cobalt, magnesium, titanium, lithium, yttrium, and cerium indicates a northeast-southwest trend for these variables, which roughly follows the distribution of lithologies in the area.

36030 (GJBX—186(80)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Gallup NTMS quadrangle, New Mexico/Arizona, including concentrations of forty-two additional elements.** Maassen, L.W.; LaDelfe, C.M.; Trujillo, D.; Minor, M.M.; Gallimore, D.L.; Martell, C.J.; Martinez, R.G.; McInteer, C. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 234p. (LA—8002-MS). NTIS, PC A11/MF A01.

LASL conducted a hydrogeochemical and stream sediment reconnaissance for uranium in the Gallup NTMS quadrangle, New Mexico/Arizona, as part of the National Uranium Resource Evaluation. Totals of 516 water and 1403 sediment samples were collected

from 1856 locations over a 20 100 km^2 area at an average density of one location per 11 km^2. Water samples were collected from streams, springs, and wells. Sediment samples were collected from streams and springs. Water samples were analyzed for uranium; sediment samples were analyzed for uranium and 41 additional elements. All field and analytical data are listed in the appendixes of this report; however, only uranium is discussed herein. The uranium concentrations in water samples range from below the detection limit of 0.02 parts per billion (ppB) to 493.53 ppB with a median for all water types of 1.60 ppB. Waters with uranium concentrations above the anomaly threshold of 20 ppB were collected predominately from shallow wells in alluvial stream beds. These streams drain primarily Chinle and Bidahochi formations in the western and southern portion of the quadrangle, and Menefee formation north of Gallup. Sediment samples from the quadrangle were found to have uranium concentrations that range from 1.00 parts per million (ppM) to 25.20 ppM with a median for all sediment types of 2.85 ppM. Three groups of sediment samples with uranium concentrations over the arbitrary anomaly threshold of 6 ppM were delineated.

36031 (GJBX—187(80)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Newcastle NTMS quadrangle, Wyoming, including concentrations of forty-two additional elements.** Goff, S.J.; Sandoval, W.F.; Gallimore, D.L.; Talcott, C.L.; Martinez, R.G.; Minor, M.E.; Mills, C.F. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 230p. NTIS, PC A11/MF A01.

During the summer and fall of 1977, 533 water and 1226 sediment samples were collected from 1740 locations within the 18,000 km^2 area of the Newcastle quadrangle, Wyoming. Water samples were collected from wells and springs; sediment samples were collected from stream channels and from springs. Each water sample was analyzed for uranium, and each sediment sample was analyzed for 43 elements, including uranium and thorium. Uranium concentrations in water samples range from below the detection limit of 0.02 ppB to 702.26 ppB and have a median of 1.73 ppB and a mean of 11.76 ppB. Water samples containing high uranium concentrations (>20 ppB) generally are associated with known uranium mining activity or units known to be uranium bearing. About one-third of the water samples containing high uranium concentrations were collected from locations within the Pumpkin Buttes and Turnercrest-Ross Districts. Nearly half of the water samples containing high uranium concentrations were collected from locations just west of the Monument Hill and Highland Flats-Box Creek Districts. Similar anomalous uranium concentrations in this region have been reported updip from Exxon's Highland uranium deposits. High uranium concentrations were also found associated with the Lance Creek-Old Woman Anticline District.

36032 (GJBX—189(80)) **Uranium hydrogeochemical and stream sediment reconnaissance data release for the Ashton NTMS quadrangle, Idaho/Montana/Wyoming, including concentrations of forty-two additional elements.** Shannon, S.S. Jr; Sandoval, W.F.; Gallimore, D.L.; Hansel, J.M.; Hensley, W.K.; Pirtle, J.; Macdonell, C.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 248p. (LA—8009-MS). NTIS, PC A11/MF A01.

This report contains data collected during a geochemical survey for uranium in the Ashton National Topographic Map Series quadrangle of eastern Idaho, southwestern Montana, and northwestern Wyoming by the Los Alamos Scientific Laboratory (LASL) as part of the nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). The LASL is responsible for conducting the HSSR primarily in the Rocky Mountain states of New Mexico, Colorado, Wyoming, and Montana and in Alaska. Totals of 1141 water and 1500 sediment samples were collected from 1539 locations in the quadrangle by a commercial contractor. Water samples were collected at streams, springs, wells, ponds, and marshes; sediment samples were obtained from streams, springs, and ponds. Histograms and statistical data for uranium concentrations in water and sediment samples and thorium concentrations in sediment samples are given. Uranium/thorium ratios for sediment samples are also included. All elemental analyses were performed at the LASL. Water samples were initially analyzed for uranium by fluorometry. All water samples containing more than 40 ppB uranium were reanalyzed by delayed-neutron counting (DNC). Sediments were analyzed for uranium and thorium as well as aluminum, antimony, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, nickel, niobium, potassium, rubidium, samarium, scandium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, and zinc. All sediments were analyzed for uranium by DNC. Other elemental concentrations in sediments were determined by neutron activation analysis for 31 elements, by x-ray fluorescence for 9 elements, and by arc-source emission spectrography for 2 elements. Analytical results for sediments are reported as parts per million.

36033 (GJBX—190(80)) **Uranium hydrogeochemical and stream sediment reconnaissance data release for the Torrington NTMS quadrangle, Wyoming, including concentrations of forty-two additional elements.** Shannon, S.S. Jr.; Romero, M.T.; Simi, O.R.; Martell, C.J.; Minor, M.M.; Hensley, W.K.; Mills, C.S. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 188p. (LA—7514-MS). NTIS, PC A09/MF A01.

This report contains data collected during a geochemical survey (August and September 1977) for uranium in the Torrington National Topographic Map Series quadrangle of east-central Wyoming by the Los Alamos Scientific Laboratory (LASL) as part of the nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). Totals of 1119 water and 756 sediment samples were collected from 1677 locations in the quadrangle. Histograms and statistical data for uranium concentrations in water and sediment samples and thorium concentrations in sediment samples are given. Elemental concentration, field measurement, weather, geologic, and geographic data for each sample location are listed for waters and for sediments. Uranium/thorium ratios for sediment samples are included. All elemental analyses were performed at the LASL. Water samples were initially analyzed for uranium by fluorometry. All water samples containing more than 40 ppB uranium were reanalyzed by delayed-neutron counting (DNC). Sediments were analyzed for uranium and thorium as well as aluminum, antimony, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, nickel, niobium, potassium, rubidium, samarium, scandium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, and zinc. All sediments were analyzed for uranium by DNC. Other elemental concentrations in sediments were determined by neutron-activation analysis for 31 elements, by x-ray fluorescence for 9 elements, and by arc-source emission spectrography for 2 elements. Analytical results for sediments are reported as parts per million.

36034 (GJBX—191(80)) **Uranium hydrogeochemical and stream sediment reconnaissance data release for Saint Johns NTMS quadrangle, Arizona/New Mexico including concentrations of forty-two additional elements.** Maassen, L.W.; George, W.E.; Apel, C.T.; Hansel, J.M.; Hensley, W.K.; Minor, M.M.; Mills, C.F. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 258p. (LA—8015-MS). NTIS, PC A12/MF A01.

This report contains data collected during a geochemical survey for uranium in the St. Johns National Topographic Map Series (NTMS) quadrangle of Arizona/New Mexico by the Los Alamos Scientific Laboratory (LASL) as part of the nationwide Hydrogeochemical and Stream Sediment Reconnaissance (HSSR). Totals of 848 water and 1475 sediment samples were collected from 2136 locations in the quadrangle. Histograms and statistical data for uranium concentrations in water and sediment samples and thorium concentrations in sediment samples are given. Listings of the field and uranium data for water samples are given in Appendix I-A. Listings of the field and elemental data for sediment samples are given in Appendix I-B. Uranium/thorium ratios for sediment samples are also included. Appendix II describes standard LASL HSSR field and analytical procedures and explains the codes used in Appendix I. Water samples were initially analyzed for uranium by fluorometry. Water samples collected in 1976 containing more than 10 ppB uranium and those collected in 1979 containing more than 40 ppB uranium were reanalyzed by delayed-neutron counting (DNC). Sediments were analyzed for uranium and thorium as well as aluminum, antimony, barium, beryllium, bismuth, cadmium, calcium, cerium, cesium, chlorine, chromium, cobalt, copper, dysprosium, europium, gold, hafnium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, nickel, niobium, potassium, rubidium, samarium, scandium, silver, sodium, strontium, tantalum, terbium, tin, titanium, tungsten, vanadium, ytterbium, and zinc. All sediments were analyzed for uranium by DNC. Other elemental concentrations in sediments were determined by neutron-activation analysis for 31 elements, by x-ray fluorescence for 9 elements, and by arc-source emission spectroscopy for 2 elements. Analytical results for sediments are reported as parts per million.

36035 (GJBX—192(80)) **Uranium and thorium potential of Bayer Process muds. Final report.** Baumgardner, L.H. (Zellars-Williams, Inc., Lakeland, FL (USA)). Jul 1980. Contract AC13-76GJ01664. 145p. NTIS, PC A07/MF A01.

The study of uranium and thorium potential of Bayer Process mud wastes of the aluminum industry was sponsored by the United States Department of Energy. Eight domestic alumina refineries and one abandoned mud impoundment were visited. Both fresh and impounded mud samples were collected and analyzed for uranium and thorium. Correlation of uranium and thorium values with specific bauxite sources was possible at only four plants. Six refineries process a multi-source blend of bauxites. Jamaican muds contained 40 ppM U_3O_8, the highest uranium content found. Maximum thorium values of 300 ppM occurred in a mud derived from a Surinam,

Guyana, and Sierra Leone blended ore. Acid extraction of less than 50 percent of the total U_3O_8 in some mud samples emphasizes the need for additional research on leaching. Mineralogical study is also recommended.

36036 (GJBX—199(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Columbia quadrangle, Tennessee and Alabama. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 362p. NTIS, PC E09/MF $4.10.

The Columbia quadrangle covers a portion of the interior lowland plateau region of the Midwestern Physiographic Province. The quadrangle contains a shallow to moderately thick Paleozoic section that overlies a Precambrian basement complex. Paleozoic carbonates dominate surficial exposures. A search of available literature revealed no known uranium deposits. Seventy-seven uranium anomalies were detected and are discussed briefly. Most anomalies appear to relate to cultural features. Some have relatively high uranium concentration levels that may be significant despite their correlation with culture. Magnetic data appear to illustrate complexities in the Precambrian basement.

36037 (GJBX—201(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Helena quadrangle of Arkansas, Mississippi and Tennessee. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 310p. NTIS, PC E08/MF $3.95.

The Helena quadrangle covers a region largely within the Mississippi River flood plain in the extreme northern Gulf Coastal Province. Tertiary sediments in this area are relatively thick, and overlie a Paleozoic basin gradually shoaling to the northeast. The Oachita Tectonic Zone strikes southeasterly through the center of the quadrangle. The exposed sequence is almost entirely Quaternary sediments of the flood plain area. Older Cenozoic deposits crop out in upland areas on the west side of the river valley. A search of available literature revealed no known uranium deposits. Sixty uranium anomalies were detected and are discussed briefly. None were considered significant, and all appeared to occur as the result of cultural and/or weather effects. Magnetic data appear to be in agreement with existing structural interpretations of the region.

36038 (GJBX—205(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Blytheville quadrangle, Tennessee, Arkansas, Alabama, and Missouri. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 360p. NTIS, PC E09/MF $4.10.

The Blytheville quadrangle covers a region east of the Mississippi River in the northernmost Gulf Coastal Province. The Tertiary Mississippi Embayment and the older Black Warrior - Arkoma Basins all shoal to the northeast in this area. Surficial exposures are dominantly Cretaceous or younger. Older strata are exposed in the northeast. A search of available literature revealed no known uranium deposits. Ninety uranium anomalies were detected and are discussed briefly. Few were considered significant,and almost all appear to relate to some cultural feature. Magnetic data appears, for the most part, to be in agreement with existing structural interpretations of the region.

36039 (LA—8490-PR) **NDA technology for uranium resource evaluation. Progress report July 1-December 31, 1979.** Evans, M.L. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

This report describes work performed during the time period from July 1, 1979 to December 31, 1979, on the contract for Nondestructive Nuclear Analysis (NDA) Technology for Uranium Resource Evaluation in Group Q-1. Calculational effort was focused on improving the accuracy with which detector response function maps can be generated for subsequent enfolding with ONETRAN angular flux data. Experimental effort was highlighted by a field test of the prototype photoneutron logging probe at the Grand Junction DOE calibration facility. The probe demonstrated adequate durability in the field and sufficient sensitivity to uranium to function at competitive logging speeds.

36040 (Y/DK—239) **Simultaneous multielement analysis of natural waters by inductively coupled plasma-optical emission spectrometry (ICP-OES).** Larson, G.F.; Goodpasture, R.T.; Morrow, R.W. (Oak Ridge Y-12 Plant, TN (USA)). 14 Dec 1979. Contract W-7405-ENG-26. 45p. (CONF-800110—3). NTIS, PC A03/MF A01.

From International conference on developments in atomic plasma spectrochemical analyses; San Juan, Puerto Rico (7 Jan 1980).

The US DOE National Uranium Resources Evaluation (NURE) Program was established to assess uranium resources and to identify favorable areas for detailed uranium exploration throughout US. A broad multielement approach was adopted for this reconnaissance survey. ICP-OES has been successfully utilized for nearly three years for the routine multielement analysis of the natural waters associated with this reconnaissance survey. Modifications which were required to automate a commercially available polychromator are described. This automated system is capable of routinely providing approximately 5000 determinations per day. An extensive quality control program is described along with the precision data obtained over an extended period of time. A real time quality control procedure is also described. The accuracy of the method is discussed from detailed investigations of several anomalous water samples.

36041 **It may not be shale.** Kowalski, J.J.; Asekun, S.O. (Amerada Hess Corp., Tulsa, OK). pp 15p, Paper P of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A study of geochemistry and mineralogical associations led to the conclusions that the Natural Gamma Ray Spectral Analysis Log could be used in determining paleo environment and sedimentary source areas. In addition, a study of Natural Gamma Ray Spectral Analysis Log showed that a large number of zones were being misinterpreted through the use of Natural Gamma Rays. The various problems encountered with the conventional Gamma Ray are illustrated in several examples and conclusions have been drawn about the effectiveness of the Natural Gamma Ray Spectral Analysis Log in evaluating reservoirs to their fullest extent. Several conclusions were drawn about the applications and interpretations that should be applied to this log.

36042 **Borehole gamma-ray spectrometer for uranium exploration.** George, D.C. (Bendix Field Engineering Corp., Grand Junction, CO); Evans, H.B.; Allen, J.W.; Key, B.N.; Ward, D.L.; Mathews, M.A. pp 33p, Paper X of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

This paper describes a system designed to measure the concentrations of potassium, uranium, and thorium in boreholes. The system is divided into a linear pulse processing subsystem that consists of the probe and part of the surface electronics, and a digital recording subsystem. Gamma rays are detected in one of two NaI crystals, and the voltage pulses resulting from the scintillations in the crystal are linearly transmitted to the surface. The pulses are separated and counted in each of three channels corresponding to a window of energies in the gamma-ray spectrum. The resulting counts are then recorded on magnetic tape and optionally listed on a printer and strip-chart recorder. The recorded data are processed at a central computer where a graphic display of potassium, uranium and thorium concentrations is constructed. Following the detailed descriptions of the spectrometer system, a section is included which suggests some geologic/lithologic relationships where this system can be applied; some examples of log data obtained with this system are also included in this paper.

36043 **Evaluation models for uranium exploration by active neutron logging.** Woolson, W.A.; Gritzner, M.L. (Science Application, Inc., La Jolla, CA). pp 26p, Paper BB of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The response of neutron logging tools for uranium exploration to variations in tool design, borehole parameters and rock matrix properties has been studied using discrete ordinates and Monte Carlo radiation transport methods. The logging techniques which have been analyzed include the measurement of delayed fission neutrons (DFN) and prompt fission neutrons (PFN) generated in uranium ore by pulsed 14-MeV and isotopic ^{252}Cf neutron sources. The effect of variations in the following parameters have been studied: source-detector separation, tool casing, borehole diameter, mud cake thickness, mud filtrate invasion, tool eccentricity, borehole casing, rock matrix composition, matrix moisture content, formation water composition, neutron poisons, thin ore beds, ore bed dipping angle, and ore grade. Noise radiation from fast fission in thorium ore and delayed oxygen neutrons (DON) have also been computed and compared to the signal radiation as a function of uranium and thorium ore grades, borehole size, and rock moisture concentration. Evaluation models have been produced to aid in calibration of the logging tools for uranium assay. 20 figures, 4 tables.

36044 **Applications of high resolution gamma ray spectroscopy to well logging.** Goldman, L.H.; Marr, H.E. pp 8p, Paper GG of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The PGT probe is a high resolution gamma ray spectroscopy tool that is effective for in-situ elemental analysis. Recent field

studies in South Texas proved that this probe had particular application for borehole assay of uranium in orebodies that are in disequilibrium. Disequilibrium can cause severe difficulties in interpretation for the well log analysts using less sophisticated instrumentation. A californium-252 source is used with the probe in an active mode to produce gamma emissions from the elements of interest. In this mode, the PGT probe has been applied to the in-situ analysis of coal, iron and copper with interesting results. Results of the field trials are presented.

36045 Multipit: a method for calibration of logging systems. Crew, M.E. pp 15p, Paper II of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A method of calibration of gamma-ray logging equipment is presented which uses data from 2 or more model holes. Input to the program is a series of count rates at equal intervals, from background to background for each model hole used. The corresponding grade thickness products (GT) are stored in the program. Using this data a simulataneous solution is made, finding the value for dead time that gives a minimum value of the sum of the least squares of the differences between the calculated and the known grade thickness products. Having found the dead time that gives the best least squares fit to a linear equation, the slope of the line is the proportionality constant or K factor.

MINING

36046 (GJBX—167(80)) **Engineering assessment and feasibility study of Chattanooga shale as a future source of uranium. Phase III.** (Mountain States Research and Development, Tucson, AZ (USA)). Jun 1979. Contract AC13-76GJ01664. 150p. NTIS MF A01.

Portions of document are illegible.

The third part of a study sponsored by the US Department of Energy, this report addresses the six major areas of concern identified in the two previous phases and at the Chattanooga Shale Conference, Oak Ridge, Tennessee, November 14 and 15, 1978. These six subject areas are: (1) optimum site locations; (2) environmental concerns; (3) shale mining methods; (4) hydrogen retorting for recovery of hydrocarbons; (5) uranium and other materials coproduction; and (6) discounted cash flow for the co-production based upon verifiable data. The problems and susequent solutions/ programs envisioned are discussed within the context of these subject areas. If considered viable, and deemed necessary as a part of this country's overall energy self-sufficiency objectives, subsequent studies will provide for the implementation of these study areas. First, an immediate, short range program for prompt implementation is suggested with a minimum financial outlay. This program would address first the crucial items that can make or block a development program and attempt to provide valid answers to some basic questions. Such a program might be accomplished on an initial budget of $1,100,000.

FEED PROCESSING

36047 (CONF-800960—1) **Recovery of uranium from lignites.** Hurst, F.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 43p. NTIS, PC A03/MF A01.

From Western regional conference on gold, silver, uranium and coal; Rapid City, SD, USA (18 Sep 1980).

Uranium in raw lignite is associated with the organic matter and is readily soluble in acid (and carbonate) solutions. However, beneficiation techniques were not successful for concentrating the uranium or removing part of the reagent-consuming materials. Once the lignite was heated, the uranium became much less soluble in both acid and carbonate solutions, and complete removal of carbon was required to convert it back to a soluble form. Proper burning improves acid-leaching efficiency; that is, it reduces the reagent consumption and concentrates the uranium, thereby reducing plant size for comparable uranium throughput, and it eliminates organic fouling of leach liquors. Restrictions are necessary during burning to prevent the uranium from becoming refractory. The most encouraging results were obtained by flash-burning lignite at 1200 to 1300°C and utilizing the released SO_2 to supplement the acid requirement. The major acid consumers were aluminum and iron.

36048 Control of pyrophoricity in deposits produced by electron beam evaporation of uranium . Clifford, J. (to Jersey Nuclear-Avco Isotopes Inc). US Patent 4,210,814. 1 Jul 1980. Filed date 9 Jan 1978. vpp.

A description is given of an apparatus for reducing the pyrophoricity of deposits of a material evaporated within a chamber comprising: a sealed chamber defined by an enclosure; means for providing within said chamber an atmosphere of generally nonreactive nature; a reservoir of a material to ve evaporated; means for directing a vapor of said material from said reservoir into said chamber; at least one surface within said chamber in the path of the directed vapor and on which at least portions of the vaporized material deposits; means for cooling said enclosure to a temperature at which said vapor deposits at a relatively low pyrophoric density; and means for maintaining a temperature for said collection surfaces higher than the enclosure temperature to promote deposition of said material at a relatively higher density.

36049 Preparation of U_3O_8. Johnson, D.R. (to Dept. of Energy). US Patent 4,201,738. 6 May 1980. Filed date 24 Aug 1978. 6p.

PAT-APPL-936,460.

A method is described for the preparation of U_3O_8 nuclear fuel material by direct precipitation of uranyl formate monohydrate from uranyl nitrate solution. The uranyl formate monohydrate precipitate is removed, dried and calcined to produce U_3O_8 having a controlled particle size distribution.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 36057, 36167

36050 (CONF-800670—3) **Redox measurements in molten urania.** Chapman, A.T.; Brynestad, J.; Clark, G.W. (Oak Ridge National Lab., TN (USA); Georgia Inst. of Tech., Atlanta (USA). School of Ceramic Engineering). 1980. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

From 7. European thermophysical properties conference; Antwerpen, Belgium (30 Jun 1980).

Urania samples were internally melted using induction heating in controlled H_2O/H_2 and CO_2/CO gas mixtures and the resultant changes in stoichiometry of the liquid measured. The temperature extremes of the pellets (interior vs surface) were employed to calculate the upper and lower limits of the oxygen pressures reacting with the molten oxide. Comparison of the redox equilibria (as determined by the molten zone temperature of 3150°K) with literature information for condensed UO/sub 2+x/ yielded a self-consistent phase diagram for the hyperstoichiometric oxide up to the liquidus curves. The experimental uncertainties and potential advantages in utilizing the internal zone technique to assess redox equilibria in nonstoichiometric molten refractory oxides are considered.

36051 (CONF-800943—(Summ.), pp 127-128) **Breeder fuel pellet fabrication from gel-sphere conversion.** McLemore, D.R.(Hanford Engineering Development Lab., Richland WA); Bennett, D.W.; Hart, P.E.; Norman, R. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36052 (CONF-800943—(Summ.), pp 129-131) **Gel sphere processes for product conversion** , Ryon, A.D.(Oak Ridge Natl. Lab., TN); Hart, P.E. (Pacific Northwest Lab., Richland, WA). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36053 (DP-MS—80-5) **Slurry calcination process for conversion of aqueous uranium and plutonium to a mixed oxide powder.** Jones, M.K.; Jenkins, W.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 23p. (CONF-800943—10). NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Pilot plant studies indicate that a slurry calcination process for conversion of uranium and plutonium solutions to a mixed oxide powder can be operated at a plant scale.

36054 Advanced accountability techniques for breeder fuel fabrication facilities. Bennion, S.I.; Carlson, R.L.; De Merschman, A.W.; Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). pp 481-489 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

The United States Department of Energy (DOE) has assigned the Hanford Engineering Development Laboratory (HEDL), operated by the Westinghouse Hanford Company, the project lead in developing a uniform nuclear materials reporting system for all contractors on the Hanford Reservation. The Hanford Nuclear Inventory System (HANISY) is based upon HEDL's real-time accountability system, originally developed in 1968. The HANISY system will receive accountability data either from entry by process operators at remote terminals or from non-destructive assay instruments connected to the computer network. Nuclear materials will be traced from entry, through processing to final shipment through the

use of mini-computer technology. Reports to DOE will be formed directly from the real-time files. In addition, HEDL has established a measurement program that will complement the HANISY system, providing direct interface to the computer files with a minimum of operator intervention. This technology is being developed to support the High Performance Fuels Laboratory (HPFL), which is being designed to assess fuel fabrication techniques for proliferation-resistant fuels.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 36018, 36093, 36102, 36163, 36169, 36170, 36667, 37031

36055 (CONF-800802—18(Draft)) **Iodine evolution from nuclear fuel dissolver solutions by air sparging.** Morgan, J.G.; Holland, W.D. (Oak Ridge National Lab., TN (USA); Tennessee Technological Univ., Cookeville (USA)). 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Iodine removal rates were measured from air-sparged nitric acid solutions in experiments designed to simulate part of the iodine recovery system in an advanced fuel reprocessing flowsheet. Variables studied were temperature, sparge rate, and iodine and acid concentrations. Experimental mass transfer coefficients were determined and compared to results based on correlations available in the literature.

36056 (CONF-800943—11) **Head-end reprocessing studies with irradiated high temperature gas-cooled reactor (HTGR) fuels.** Fitzgerald, C.L.; Vaughen, V.C.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Fifty (U-2.75 Th)C_2 and ThC_2 coated-particle fuel rods irradated in Peach Bottom were crushed and burned. The fertile and fissile fractions were separated using Thorex reagent and chemical analyses conducted for carbon, heavy metals, and fission products. Results were generally consistent with predictions, indicating that the reprocessing of TRISO-BISO fuel can be accomplished by the proposed flowsheet steps of crushing, fluidized-bed burning, coated particle separation and crushing, secondary burning, dissolution, clarification, and solvent extraction. (DLC)

36057 (CONF-800943—(Summ.)) **Fuel cycles for the 80's.** (American Nuclear Society, Oak Ridge, TN). 1980. 170p. NTIS, PC A08/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Papers presented at the American Nuclear Society's topical meeting on the fuel cycle are summarized. Present progress and goals in the areas of fuel fabrication, fuel reprocessing, spent fuel storage, accountability, and safeguards are reported. Present governmental policies which affect the fuel cycle are also discussed. Individual presentations are processed for inclusion in the Energy Data Base.(DMC)

36058 (CONF-800943—(Summ.), pp 10-11) **Comparative economics of nuclear fuels reprocessing.** Condotta, D.L.; Malody, C.W.; Tomlinson, R.E. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36059 (CONF-800943—(Summ), pp 14-17) **Voloxidation studies with UO_2 reactor fuels.** Stone, J.A. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36060 (CONF-800943—(Summ.), pp 18-21) **Voloxidation and dissolution of irradiated plutonium recycle fuels.** Cadieux, J.R.; Stone, J.A. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36061 (CONF-800943—(Summ.), pp 22-23) **Hot cell studies of tritium removal and dissolution of an irradiated thoria fuel.** Pickett, J.B. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36062 (CONF-800943—(Summ.), pp 24-28) **Head-end reprocessing studies with irradiated high temperature gas-cooled reactor (HTGR) fuels.** Fitzgerald, C.L.; Vaughen, V.C.A. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36063 (CONF-800943—(Summ.), pp 33-34) **Solvent extraction studies of coprocessing flowsheets.** Collins, E.D.; Benker, D.E.; Bigelow, J.E.; Chattin, F.R.; King, L.J.; Lloyd, M.H.; Ross, R.G.; Savage, H.C. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36064 (CONF-800943—(Summ.), pp 35-36) **Laboratory studies of uranium(IV) in the Purex process.** Thompson, M.C. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36065 (CONF-800943—(Summ.), pp 37-40) **Polymerization of Pu(IV) in aqueous nitric acid solutions.** Toth, L.M.; Friedman, H.A.; Osborne, M.M. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36066 (CONF-800943—(Summ.), pp 72-76) **Role of the consolidated fuel reprocessing program in the United States Breeder Reactor program.** Ballard, Contract W.W.(Dept. of Energy, Washington, D.C.); Burch, W.D. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36067 (CONF-800943—(Summ.), pp 77-81) **Facility and equipment concepts for the Hot Experimental Facility.** White, J.R.; Bottenfield, B.F.; North, E.D. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36068 (CONF-800943—(Summ.), pp 92-93) **Design of air lift systems for transfers and measurements of radioactive liquids.** Dabolt, R.J. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36069 (CONF-800943—(Summ.), pp 94-98) **Remotex - a new concept for efficient remote operations and maintenance in nuclear fuel reprocessing.** Feldman, M.J.; White, J.R. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36070 (CONF-800943—(Summ.), pp 99-100) **Solvent extraction design improvement and safeguards development.** Engler, D.R. (General Atomic Co., San Diego, CA). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36071 (CONF-800943—(Summ.), pp 101-103) **BNFP centrifugal contactor experience.** Plummer, K.E. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36072 (CONF-800943—(Summ.), pp 112-113) **Alpha-contained laboratory-scale pulse column facility for SRL.** Reif, D.J.; Cadieux, J.R.; Fauth, D.J.; Thompson, M.C. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36073 (CONF-800943—(Summ.), pp 114-117) **Contactors selection for a nuclear fuel reprocessing plant.** Cermak, A.F. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36074 (CONF-800943—(Summ.), pp 124-126) **Safety evaluation of a conceptual fuel recycle complex.** Hodges, M.E. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36075 (CONF-800943—(Summ.), pp 135-137) **Mixed oxide conversion facility alternative conceptual designs.** Thomas, L.L. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36076 (CONF-800943—(Summ.), pp 151-154) **Development of reprocessing technology for breeder recycle.** Groenier, W.S.; Crouse, D.J.; Vondra, B.L. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36077 (CONF-800943—(Summ.), pp 159-160) **Conceptual design of a spent LWR fuel recycle complex.** Kirk, B.H. (E.I. du Pont de Nemours & Co., (Inc.), Wilmington, DE). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36078 (CONF-801107—16) **Unique sampling and transfer system for the Fluorinel Dissolution and Storage Facility.** Jacobson, M.E.; Carter, J.A.; Paige, D.M. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 5p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Liquid sampling, sample transfer and analytical systems for the Fluorinel Dissolution and Storage Facility (FAST) are required for monitoring feed and process solutions on a constant basis during fuel dissolution. Due to sequential batch dissolution, sampling becomes important in monitoring and tracking the dissolution phase of each dissolver. The sampling cell contains 10 liquid samplers, a pneumatic sample transfer sender/receiver, a decontamination service station, plastic transfer capsule capper/decapper and a sample bottle evacuation chamber. A mockup of the sampling cell has been installed for equipment checkout and personnel training in the Remote Maintenance Test Facility (RMTF).

36079 (DP-MS—80-11) **Hot cell studies of tritium removal from and dissolution of an irradiated thoria fuel.** Pickett, J.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 27p. (CONF-800943—8). NTIS, PC A03/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Tritium removal and dissolution studies on an irradiated thoria-based fuel were conducted in the High Level Caves at the Savannah River Laboratory (SRL). The objectives of these studies were to define the effects of key process-related parameters on tritium evolution and subsequent dissolution. The test program at SRL determined the effects on tritium removal of particle size, heating temperature, oxidation, and agitation. ThO_2/UO_2 (95%/5%) fuel from the Elk River Reactor, irradiated to about 12,000 MWD/MTHM and cooled for about 12 years, was used in the tests. The thoria/urania fuel pellets were separated from the stainless steel cladding and were divided into size fractions to determine the particle-size distribution resulting from the decladding process. In the tritium removal tests, the effect of heating several different particle-size fractions was studied at temperatures ranging from 600 to 1000°C in the presence of air for 10 to 30 hours. Each of the roasted samples (about 100 grams) was subsequently dissolved in refluxing Thorex reagent [13M HNO_3, 0.05M HF, and 0.1M $Al(NO_3)_3$] to determine the residual tritium. The amount of insoluble residue remaining after the dissolution was determined and characterized.

36080 (ENICO—1055) **Preliminary safety evaluation of a commercial-scale krypton-85 encapsulation facility.** Christensen, A.B.; Tanner, J.E.; Knecht, D.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-79ID01675. 54p. NTIS, PC A04/MF A01.

This report demonstrates that a commercial-scale facility for encapsulating krypton-85 in zeolite-5A or glass at a 2000 MTHM per year nuclear fuel reprocessing plant can be designed to contain fragments and the 340 to 850 kCi krypton-85 inventory from an assumed catastrophic failure of the high pressure vessel. The vessel failure was assumed as a worst case and was not based on a detailed design evaluation or operating experience. The process design is based on existing commercial hot isostatic pressing technology operated at up to 40 times the scale required for krypton encapsulation. From the calculated process gas inventory in the pressure vessel and vessel design, the explosive energy of 8.4 kg TNT and vessel plug and fragment velocities were calculated. The facility Containment Cell housing the high pressure vessel was designed to contain the gases, fragments, and the shock wave energy calculated for vessel failure. The Access Cell located directly above the Containment Cell was designed to be a tertiary confinement of krypton-85, should the access hatch be breached.

36081 (ORNL/TM—7430) **Consolidated fuel reprocessing. Program progress report, April 1-June 30, 1980.** (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 48p. NTIS, PC A03/MF A01.

This progress report is compiled from major contributions from three programs: (1) the Advanced Fuel Recycle Program at ORNL; (2) the Converter Fuel Reprocessing Program at Savannah River Laboratory; and (3) the reprocessing components of the HTGR Fuel Recycle Program, primarily at General Atomic and ORNL. The coverage is generally overview in nature; experimental details and data are limited.

36082 **Continuous-flow free acid monitoring method and system.** Strain, J.E.; Ross, H.H. (to Dept. of Energy). US Patent Application 111,496. 11 Jan 1980. 17p.

A free acid monitoring method and apparatus is provided for continuously measuring the excess acid present in a process stream. The disclosed monitoring system and method is based on the relationship of the partial pressure ratio of water and acid in equilibrium with an acid solution at constant temperature. A portion of the process stream is pumped into and flows through the monitor under the influence of gravity and back to the process stream. A continuous flowing sample is vaporized at a constant temperature and the vapor is subsequently condensed. Conductivity measurements of the condensate produces a nonlinear response function from which the free acid molarity of the sample process stream is determined.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 36057, 36103, 36104, 36111, 36140, 36144, 36164, 36171, 36680

36083 (CONF-800943—(Summ.), pp 42-44) **DOE's spent fuel program talk.** Lawrence, M.J. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36084 (CONF-800943—(Summ.), pp 45-48) **Economics of spent LWR fuel storage.** Clark, H.J.; O'Neill, G.F. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36085 (CONF-800943—(Summ.), pp 49-52) **Determination of away-from-reactor storage requirements.** Thomas, A.B. (Savannah River Plant, Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36086 (CONF-800943—(Summ.), pp 53-55) **Licensing of away-from-reactor (AFR) installations.** Gray, P.L. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36087 (CONF-800943—(Summ.), pp 56-59) **Spent fuel dry storage concepts.** Anderson, K.J. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36088 (CONF-800943—(Summ.), pp 60-64) **High-density rack concepts for AFR fuel storage pools.** Anderson, R.T. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36089 (DP-MS—80-31) **Licensing of away-from-reactor (AFR) installations.** Gray, P.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 18p. (CONF-800943—9). NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Storage of spent fuel at Away-From-Reactor (AFR) installations will allow reactors to continue to operate until reprocessing or other fuel disposal means are available. AFR installations must be licensed by the Nuclear Regulatory Commission (NRC). Although wide experience in licensing reactors exists, the licensing of an AFR installation is a relatively new activity. Only one has been licensed to date. This paper delineates the requirements for licensing an AFR installation and projects a licensing schedule. Because the NRC is developing specific AFR requirements, this schedule is based primarily on draft NRC documents. The major documents needed for an AFR license application are similar to those for a reactor. They include: a Safety Analysis Report (SAR), and Environmental Report (ER), safeguards and security plans, decommissioning plans, proposed technical specifications, and others. However, the licensing effort has one major difference in that for AFR installations it will be a one-step effort, with follow-up, rather than the two-step process used for reactors. The projected licensing schedule shows that the elapsed time between filing an application and issuance of a license will be about 32 months, assuming intervention. The legal procedural steps will determine the time schedule and will override considerations of technical complexity. A license could be issued in about 14 months in the absence of intervention.

36090 (PNL—3017) **Opportunities to increase the productivity of spent fuel shipping casks in the United States.** Winsor, G.H.; Faletti, D.W.; DeSteese, J.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 89p. (TTC—0078). NTIS, PC A05/MF A01.

Trends indicate that future transportation requirements for spent fuel will be different from those anticipated when the current

generation of casks and vehicles was designed. Increased storage capacity at most reactors will increase the average post irradiation age of the spent fuel to be transported. A scenario is presented which shows the 18 casks currently available should be sufficient until approximately 1983. Beyond this time, it appears that an adequate transportation system can be maintained by acquiring, as needed, casks of current designs and new casks currently under development. Spent fuel transportation requirements in the post-1990 period can be met by a new generation of casks specifically designed to transport long-cooled fuel. In terms of the number of casks needed, productivity may be increased by 19% if rail cask turnaround time is reduced to 4 days from the current range of 6.5 to 8.5 days. Productivity defined as payloads per cask year could be increased 62% if the turnaround time for legal weight truck casks were reduced from 12 hours to 4 hours. On a similar basis, overweight truck casks show a 28% increase in productivity.

36091 (PNL—3208) **TRECII: a computer program for transportation risk assessment.** Franklin, A.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 89p. (TTC—0116). NTIS, PC A05/MF A01.

A risk-based fault tree analysis method has been developed at the Pacific Northwest Laboratory (PNL) for analysis of nuclear fuel cycle operations. This methodology was developed for the Department of Energy (DOE) as a risk analysis tool for evaluating high level waste management systems. A computer package consisting of three programs was written at that time to assist in the performance of risk assessment: ACORN (draws fault trees), MFAULT (analyzes fault trees), and RAFT (calculates risk). This methodology evaluates release consequences and estimates the frequency of occurrence of these consequences. This document describes an additional risk calculating code which can be used in conjunction with two of the three codes for transportation risk assessment. TRECII modifies the definition of risk used in RAFT (prob. x release) to accommodate release consequences in terms of fatalities. Throughout this report risk shall be defined as probability times consequences (fatalities are one possible health effect consequence). This methodology has been applied to a variety of energy material transportation systems. Typically the material shipped has been radioactive, although some adaptation to fossil fuels has occurred. The approach is normally applied to truck or train transport systems with some adaptation to pipelines and aircraft. TRECII is designed to be used primarily in conjunction with MFAULT; however, with a moderate amount of effort by the user, it can be implemented independent of the risk analysis package developed at PNL. Code description and user instructions necessary for the implementation of the TRECII program are provided.

36092 (PNL—3261) **Application of ALARA principles to shipment of spent nuclear fuel.** Greenborg, J.; Brackenbush, L.W.; Murphy, D.W. Burnett, R.A.; Lewis, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 99p. (TTC—0073). NTIS, PC A05/MF A01.

The public exposure from spent fuel shipment is very low. In view of this low exposure and the perfect safety record for spent fuel shipment, existing systems can be considered satisfactory. On the other hand, occupational exposure reduction merits consideration and technology improvement to decrease dose should concentrate on this exposure. Practices that affect the age of spent fuel in shipment and the number of times the fuel must be shipped prior to disposal have the largest impact. A policy to encourage a 5-year spent fuel cooling period prior to shipment coupled with appropriate cask redesign to accommodate larger loads would be consistent with ALARA and economic principles. And finally, bypassing high population density areas will not in general reduce shipment dose.

36093 (RFP—2982) **Chemistry research and development. Progress report, December 1978-May 1979.** Miner, F.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 30 Jun 1980. Contract AC04-76DP03533. 60p. NTIS, PC A04/MF A01.

Progress and activities are reported on component development, pilot plant development, and instrumentation and statistical systems. Specific items studied include processing of pond sludge, transport of radioactive materials and wastes, corrosion, decontamination and cleaning, fluidized-bed incineration, Pu contamination of soils, chemical analysis, radiometric analysis, security. (DLC)

36094 (SAND—80-1633C) **Analysis and model testing of a Super Tiger Type B waste transport system in accident environments.** May, R.A.; Yoshimura, H.R.; Romesberg, L.E.; Joseph, B.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 4p. (CONF-801107—10). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Sandia National Laboratories is investigating the response of a Type B packaging containing drums of contact-handled transuranic waste (CH-TRU) as a part of a program to evaluate the adequacy of experimental and analytical methods for assessing the safety of waste transport systems in accident environments. A US NRC certified Type B package known as the Super Tiger was selected for the study. This overpack consists of inner and outer steel shells separated by rigid polyurethane foam and can be used for either highway or rail transportation. Tests using scale models of the vehicular system are being conducted in conjunction with computer analyses.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 36058, 36084, 36666, 36667

36095 (PNL—3317-2) **Commercial US nuclear reactors and waste: the current status.** Platt, A.M.; Robinson, J.V. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 53p. NTIS, PC A04/MF A01.

Between March 1 and June 15, 1980, the declared size of the commercial light waste reactor (LWR) nuclear power industry in the US has decreased another 9 GWe. For the presently declared size: the 165 declared reactors will peak at a capacity of 153 GWe in 2001 and will consume about 870,000 MTU as enrichment feed; the theoretical rate of enrichment requirements will peak at about 19,000,000 SWUs/y in the year 2014; as few as two repositories each with capacity equivalent to 100,000 MTU would hold the waste; and predisposal storage reactor basins and AFRs (away-from-reactor basins) would peak at $<$85,000 MTU in the year 2020 if the two respositories were commissioned in the years 1997 and 2020. It should be noted that the number of declared LWRs has dropped from 226 on December 31, 1974 to 165 as of this writing. The oil equivalent of the energy loss, assuming a 50% efficiency in use as in cars, is 17,000 million barrels. This is about 10 years of the current rate of US consumption of OPEC oil.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 36969

36096 (CONF-800943—(Summ.), pp 6-8) **Waste management R & D for the nuclear fuel cycle.** McElroy, J.L. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36097 (CONF-800987—2) **Leach testing of Idaho Chemical Processing Plant final waste forms.** Schuman, R.P. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 21p. NTIS, PC A02/MF A01.

From Workshop on comparative leaching behavior of radioactive waste forms; Argonne, IL, USA (3 Sep 1980).

A number of pellets and highly durable glasses prepared from nonradioactive-simulated high-level wasste calcines have been leach tested. The leach tests are patterned on the IAEA standard test and the proposed Materials Characterization Center tests. Most tests are made with static distilled water at 25, 70, 95, 250, and 350°C and in refluxing distilled water, Soxhlet, at 95°C. Leach rates are determined by analyzing the leachate by instrumental activation analysis or spectrochemical analysis and from weight loss. Leaches are run on glass using cast and core drilled cylinders, broken pieces and coarse ground material. Sample form has a considerable effect on leach rates; solid pieces gave higher leach rates than ground glass when expressed in g/cm^2/day. Cesium, molybdenum and weight loss leach rates of cast glass cylinders in distilled water varied from $<10^{-7}$ g/cm^2/day at 25°C to $\sim 10^{-3}$ g/cm^2/day at 250°C. The leach rates in static distilled water at 95°C were considerably lower than those in refluxing distilled water, Soxhlet, at the same temperature. Even at 25°C, sodium, cesium, and molybdenum readily leached from the porous pellets, but the pellets showed no visible attack, even at 250°C.

36098 (DOE/SR-WM—79-1(Suppl.)) **Defense transuranic waste at the Savannah River Plant, Aiken, South Carolina. Supplemental alternatives for long-term management.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1980. Contract AC09-76SR00001. 53p. NTIS, PC A04/MF A01.

Costs and risks are estimated for four supplemental alternatives for the long-term management of retrievably stored defense transuranic solid waste now stored in trenches and on pads at the Savannah River Plant. These alternatives supplement the twelve alternatives described in Reference 1. Alternatives for Long-Term Management of Defense Transuranic Waste at the Savannah River Plant, Aiken, South Carolina, by adding the use of the planned Alpha Waste Incinerator and Alpha Disassembly and Decontamination facilities to process retrievable stored TRU solid waste. The four supplemental alternatives are compared with three of the twelve alternatives described in Reference 1.

36099 (EGG-WM—5233) **Development of criteria and standards for management of low-level radioactive waste.** Grey, A.E.; Falconer, K.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1980. Contract AC07-76ID01570. 37p. NTIS, PC A03/MF A01.

The basic need for criteria and standards for radioactive waste management is to ensure compliance with Federal and State regulations applicable to this activity. In addition, criteria and standards can establish the parameters by which a radioactive waste disposal site is selected, the form in which the waste is to be disposed, how a disposal site is to be operated, and how that site is to be closed when it reaches the end of its useful life. For developing criteria and standards, this report discusses the nature of low-level radioactive waste and the role government agencies play in regulating its management. It describes subject areas for which criteria and standards could be developed, current and evolving requirements, and future suggested analyses.

36100 (ORNL/TM—7385/V1) **Radioactive waste management integrated data base: a bibliography.** Johnson, C.A.; Garland, P.A. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 192p. NTIS, PC A09/MF A01.

The purpose of this indexed bibliography is to organize and collect the literature references on waste generation and treatment, characteristics, inventories, and costs. The references were captured into a searchable information file, and the information file was sorted, indexed, and printed for this bibliography. A completion of approximately 1100 references to nuclear waste management, the first of a series, is completed. Each reference is categorized by waste origin (commercial, defense, institutional, and foreign) and by subject area: (1) high-level wastes, (2) low-level wastes, (3) TRU wastes, (4) airborne wastes, (5) remedial action (formerly utilized sites, surplus facilities, and mill tailings), (6) isolation, (7) transportation, (8) spent fuel, (9) fuel cycle centers, and (10) a general category that covers nonspecific wastes. Five indexes are provided to assist the user in locating documents of interest: author, author affiliation (corporate authority), subject category, keyword, and permuted title. Machine (computer) searches of these indexes can be made specifying multiple constraints if so desired. This bibliography will be periodically updated as new information becomes available. In addition to being used in searches for specific data, the information file can also be used for resource document collection, names and addresses of contacts, and identification of potential sources of data.

36101 (ORNL/TM—7385/V2) **Radioactive waste management integrated data base: a bibliography.** Johnson, C.A.; Garland, P.A. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 409p. NTIS, PC A18/MF A01.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 36055, 36080, 36093, 36137

36102 (BNL—28282) **APEX accelerator cycle for transmutation of long-lived fission wastes.** Powell, J.; Steinberg, M.; Takahashi, H.; Grand, P.; Botts, T.; Kouts, H.J.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 30p. (CONF-800743—11). NTIS, PC A03/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

Based on preliminary studies, some conclusions can be drawn concerning the Accelerator Fuel Enricher and Fission Product Exterminator (APEX). APEX-1 and APEX-2 systems can destroy TU's, ^{137}Cs, and ^{90}Sr at acceptable cost and efficiency. The principal difference between APEX-1 and APEX-2 is the in-reactor and in-circuit inventory of ^{137}Cs and ^{90}Sr. Stable and low hazard wastes can be disposed of by burial. Accelerator breeders can effectively sustain a fission reactor economy indefinitely. Military waste can be blended into commercial fuel cycle for transmutation. Accelerator and target technologies appear practical and could be developed in a few years. More detailed studies are needed to better define the technical and economic features of the LAFER and APEX cycles, so that comparative assessments can be made between these cycles, as well as with other transmutation and waste disposal concepts.

36103 (CONF-800943—(Summ.), pp 65-67) **Spent-fuel disassembly and canning programs at the Barnwell Nuclear Fuel Plant (BNFP).** Townes, G.A. (Allied-General Nuclear Services, Barnwell, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36104 (CONF-800943—(Summ.), pp 68-70) **Underwater fuel disassembly and rod storage summary.** Viebrock, J.M.; Malin, D.H. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36105 (ORNL/TM—7130) **In-situ stabilization of radioactively contaminated low-level solid wastes buried in shallow trenches: an assessment.** Arora, H.S.; Tamura, T.; Boegly, W.J. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 67p. NTIS, PC A04/MF A01.

The potential effectiveness of materials for in-situ encapsulation of low-level, radioactively contaminated solid waste buried in shallow trenches is enumerated. Cement, clay materials, and miscellaneous sorbents, aqueous and nonaqueous gelling fluids and their combinations are available to solidify contaminated free water in trenches, to fill open voids, and to minimize radionuclide mobility. The success of the grouting technique will depend on the availability of reliable geohydrologic data and laboratory development of a mix with enhanced sorption capacity for dominant radionuclides present in the trenches. A cement-bentonite-based grout mix with low consistency for pumping, several hours controlled rate of hardening, negligible bleeding, and more than 170 kPa (25 psi) compressive strength are a few of the suggested parameters in laboratory mix development. Cost estimates of a cement-bentonite-based grout mix indicate that effective and durable encapsulation can be accomplished at a reasonable cost (about $113 per cubic meter). However, extensive implementation of the method suggests the need for a field demonstration of the method. 53 references.

36106 (ORNL/TM—7476) **High-level waste program progress report, April 1, 1980-June 30, 1980.** (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

The highlights of this report are on: waste management analysis for nuclear fuel cycles; fixation of waste in concrete; study of ceramic and cermet waste forms; alternative high-level waste forms development; and high-level waste container development.

36107 (ORO—777) **Description of the Formerly Utilized Sites Remedial Action Program.** (Department of Energy, Oak Ridge, TN (USA). Oak Ridge Operations Office). Sep 1980. 85p. NTIS, PC A05/MF A01.

The background and the results to date of the Department of Energy program to identify and evaluate the radiological conditions at sites formerly utilized by the Corps of Engineers' Manhattan Engineer District (MED) and the US Atomic Energy Commission (AEC) are summarized. The sites of concern were federally, privately, and institutionally owned and were used primarily for research, processing, and storage of uranium and thorium ores, concentrates, or residues. Some sites were subsequently released for other purposes without radiological restriction. Surveys have been conducted since 1974 to document radiological conditions at such sites. Based on radiological surveys, sites are identified in this document that require, or are projected to require, remedial action to remove potential restrictions on the use of the property due to the presence of residual low-level radioactive contamination. Specific recommendations for each site will result from more detailed environmental and engineering surveys to be conducted at those sites and, if necessary, an environmental impact assessment or environmental impact statement will be prepared. Section 3.0 describes the current standards and guidelines now being used to conduct remedial actions. Current authority of the US Department of Energy (DOE) to proceed with remedial actions and the new authority required are summarized. A plan to implement the Formerly Utilized Sites Remedial Action Program (FUSRAP) in accordance with the new authority is presented, including the objectives, scope, general approach, and a summary schedule. Key issues affecting schedule and cost are discussed.

36108 (PNL—3493) **Safety assessment of the liquid-fed ceramic melter process.** Buelt, J.L.; Partain, W.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 113p. NTIS, PC A06/MF A01.

As part of its development program for the solidification of high-level nuclear waste, Pacific Northwest Laboratory assessed the safety issues for a complete liquid-fed ceramic melter (LFCM) process. The LFCM process, an adaption of commercial glass-making technology, is being developed to convert high-level liquid waste from the nuclear fuel cycle into glass. This safety assessment uncovered no unresolved or significant safety problems with the LFCM process. Although in this assessment the LFCM process was not directly compared with other solidification processes, the safety hazards of the LFCM process are comparable to those of other processes. The high processing temperatures of the glass in the LFCM pose no additional significant safety concerns, and the dispersible inventory of dried waste (calcine) is small. This safety assessment was based on the nuclear power waste flowsheet, since power waste is more radioactive than defense waste at the time of solidification, and all accident conditions for the power waste would have greater radiological consequences than those for defense waste. An exhaustive list of possible off-standard conditions and equipment failures was compiled. These accidents were then classified according to severity of consequence and type of accident. Radionuclide releases to the stack were calculated for each group of accidents using conservative assumptions regarding the retention and decontamination features of the process and facility. Two recommenda-

tions that should be considered by process designers are given in the safety assessment.

36109 **Decommissioning of a ^{239}Pu contaminated incinerator facility.** Harper, J.; Garde, R. (Los Alamos Scientific Lab., NM (USA)). pp 601-607 of Decommissioning of nuclear facilities. Proceedings of an international symposium jointly organized by the IAEA and the OECD NEA and held in Vienna, 13-17 November 1978. Vienna; IAEA (1979).

From International symposium on the decommissioning of nuclear facilities; Vienna, Austria (13 Nov 1978).

In early 1978, a plutonium contaminated incinerator facility at the Los Alamos Scientific Laboratory (LASL), Los Alamos, New Mexico, was decommissioned. The project involved dismantling the facility and disposal by burial or by retrievable storage of the debris at an on-site waste disposal area. Contaminated soil from the 0.5 hectare area was buried. The facility was constructed in 1951 to incinerate plutonium contaminated wastes. It was later used as a decontamination facility. The major features included a 185 m^2 control building, incinerator, cyclone dust collector, spray cooler, venturi scrubber, air filter bank, ash separator, and two 140,000 litres ash storage tanks. Preliminary soil contamination surveys were performed by a LASL developed portable phoswich detector system. Final soil contamination levels were measured with a zinc sulphide gross alpha scintillation system. Six hundred cubic metres of debris and 1200 m^3 of soil contaminated with less than 10 nCi ^{239}Pu/g were buried at the LASL disposal area. Five cubic metres of ^{239} Pu contaminated ash residues were packed and stored to meet the Department of Energy's 20 year retrievable storage criteria.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 36057, 36083, 36084, 36085, 36086, 36087, 36088, 36089, 36095, 36105, 36151, 36152, 36153, 36154, 36155, 36156, 36157, 36158, 36159, 36160, 36161, 36162, 36171, 36508, 37181, 37251, 37253, 37254, 37256, 37258, 37259

36110 (AD-B—024442/6) **Borehole plugging program (waste disposal). report 1. initial investigations and preliminary data. Miscellaneous paper.** Boa, J.A. Jr. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Jan 1978. 39p. NTIS, PC A03/MF A01.

This report covers efforts during the first year of the program. A study was initiated to find competent grouts to be used in stemming boreholes associated with radioactive waste disposal. The grouts must be durable for several thousand years and be essentially impermeable. In addition, the grouts should be pumpable to depths of several thousand feet into environments of high temperature. Grouts for use in both salt and nonsalt formations are to be studied. This program is still underway.

36111 (CONF-801102—14) **UCRL—84153.** Altenbach, T.J.; Lowry, W.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A three-dimensional thermal analysis has been performed using finite difference techniques to determine the near-field response of a baseline spent fuel repository in a deep geologic salt medium. A baseline design incorporates previous thermal modeling experience and OWI recommendations for areal thermal loading in specifying the waste form properties, package details, and emplacement configuration. The base case in this thermal analysis considers one 10-year old PWR spent fuel assembly emplaced to yield a 36 kw/acre (8.9 w/m^2) loading. A unit cell model in an infinite array is used to simplify the problem and provide upper-bound temperatures. Boundary conditions are imposed which allow simulations to 1000 years. Variations studied include a comparison of ventilated and unventilated storage room conditions, emplacement packages with and without air gaps surrounding the canister, and room cool-down scenarios with ventilation following an unventilated state for retrieval purposes. At this low power level ventilating the emplacement room has an immediate cooling influence on the canister and effectively maintains the emplacement room floor near the temperature of the ventilating air. The annular gap separating the canister and sleeve causes the peak temperature of the canister surface to rise by 10°F (5.6°C) over that from a no gap case assuming perfect thermal contact. It was also shown that the time required for the emplacement room to cool down to 1000°C) from an unventilated state ranged from 2 weeks to 6 months; when ventilation initiated after times of 5 years to 50 years, respectively. As the work was performed for the Nuclear Regulatory Commission, these results provide a significant addition to the regulatory data base for spent fuel performance in a geological repository.

36112 (LBL—8648, pp 199-209) **Swedish-American cooperative program on radioactive waste storage in mined caverns in crystalline rock.** Witherspoon, P.A.; Cook, N.G.W.; Gale, J.E. 1978.

In Earth Sciences Division. Annual Report 1978.

36113 (LBL—8648, pp 214-215) **Very deep hole concept: evaluation of an alternative for nuclear waste disposal.** O'Brien, M.T.; Cohen, L.H.; Narasimhan, T.N.; Simkin, T.L.; Wollenberg, H.A.; Brace, W.F.; Green, S.; Pratt, H.P. 1978.

In Earth Sciences Division. Annual Report 1978.

36114 (LBL—8648, pp 215-218) **Geotechnical assessment and instrumentation needs for nuclear waste isolation in crystalline and argillaceous rocks.** O'Brien, M.T. 1978.

In Earth Sciences Division. Annual Report 1978.

36115 (LBL—8648, pp 219-228) **Geohydrological studies for nuclear waste isolation at the Hanford Reservation.** Apps, J.; Doe, T.; Doty, B. 1978.

In Earth Sciences Division. Annual Report 1978.

36116 (LBL—8648, pp 241-246) **Waste Isolation Safety Assessment Program.** Silva, R.J.; Benson, L.V.; Apps, J.A. 1978.

In Earth Sciences Division. Annual Report 1978.

36117 (LBL—10876) **Heat transfer in underground heating experiments in granite, Stipa, Sweden.** Chan, T.; Javandel, I.; Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 29p. (CONF-801102—17). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Electrical heater experiments have been conducted underground in granite at Stripa, Sweden, to investigate the effects of heating associated with nuclear waste storage. Temperature data from these experiments are compared with closed-form and finite-element solutions. Good agreement is found between measured temperatures and both types of models, but especially for a nonlinear finite-element heat conduction model incorporating convective boundary conditions, measured nonuniform initial rock temperature distribution, and temperature-dependent thermal conductivity. In situ thermal properties, determined by least-squares regression, are very close to laboratory values. A limited amount of sensitivity analysis is undertaken.

36118 (ONWI—88) **Waste isolation performance assessment and in-situ testing.** Maass, K.E.; Pomplun, E.; Weis, M. (eds.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tieflagerung; Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)). 1979. Contract EY-76-C-06-1830. 435p. (CONF-791087—). NTIS, PC A19/MF A01.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Thirty-three papers and summaries are included, under the categories of plenary lectures, performance assessment, and Asse experiments. Separate abstracts were prepared for 27 of the papers; one was previously abstracted. (DLC)

36119 (ONWI—88, pp 7-14) **Overview of some current US design concepts for nuclear waste/spent fuel repositories in salt.** Claiborne, H.C. (Oak Ridge National Lab., TN). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Conceptual designs for geologic disposal of high-level waste or spent fuel elements in salt deposits are compared with each other and with the reference repository design which is under development. 2 figures, 2 tables. (DLC)

36120 (ONWI—88, pp 15-36) **FRG conceptual design and design basis.** Roethemeyer, H. (Physikalisch-Technische Bundesanstalt, Braunschweig, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

For the site-independent conceptual design the following requirements have been laid down: (1) for safety reasons retrievability is not considered; (2) standard mining techniques and experience gained at Asse should be used; (3) two shafts should be sufficient; (4) different waste forms and containers shall be disposed of in different storage areas; (5) ventilated sections must allow the shutting off of each storage area from the rest of the mine; (6) the mining method of retreat working should be applied; (7) the mine works shall have a lateral safety distance to the caprock of 200 m and a vertical safety zone beneath salt level of 300 m; (8) all disposal areas shall be on one level; (9) salt and waste shall be transported in different drifts, mainly in a one way system.

36121 (ONWI—88, pp 37-61) **Project SAFETY-STUDIES ENTSORGUNG in the Federal Republic of Germany.** Levi, H.W. (Hahn-Meitner-Institut fuer Kernforschung Berlin, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The project SAFETY-STUDIES ENTSORGUNG (PSE) has been initiated by the Federal Ministry of Research and Technology. Entsorgung stands for back-end of the fuel cycle. Purpose of PSE is to analyze important safety aspects of the German nuclear Entsorgungs-Center (NEC) in considerable depth, to collect reliability and performance data, to adapt or to develop models and computer programs concerning radionuclide release mechanisms and release consequences and eventually to test them out with suitable subsystems of the NEC. Much of the efforts spent in PSE is devoted to the geologic subsystem, the waste repository. Two points are considered important pecularities of waste repository safety analyses: employment of a deterministic rather than of a probabilistic approach, and definition of a significant period of the waste repository hazard to serve as a guideline for a time limitation of the analysis.

36122 (ONWI—88, pp 62-74) **US performance assessment.** Burkholder, H.C. (Battelle Memorial Inst., Columbus, OH). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Viewographs are given illustrating the procedures used in assessing the performance of nuclear wasste isolation. The procedures include the ONWI, WIPP, BWIP, NRC-LLL, EPRI, EPA, and NRC-Sandia programs. (DLC)

36123 (ONWI—88, pp 75-82) **US in-situ studies in salt.** Robinson, R.A. (Battelle Memorial Inst., Columbus, OH). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The in-situ field tests are necessary to provide data for performance assessment model verification and for comparison to a much broader data base obtained in laboratory and engineering-scale facilities. The justification for conducting relatively large and costly in-situ experiments is to encompass important geologic variables (e.g., lithostatic stress fields, heterogeneous geologic properties, and local hydrologic factors) that cannot be adequately simulated in a laboratory environment. Also, there is a need to examine possible synergistic effects such as coupling and feedback of temperature, radiation, stress relaxation, etc., that cannot be completely evaluated in a laboratory environment.

36124 (ONWI—88, pp 83-97) **German in-situ studies in salt.** Kuehn, K. (Gesellschaft fuer Strahlen- und Umweltforschung, Clausthal-Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The overall objective for the German program of radioactive waste disposal is construction and operation of a repository for all waste categories in a salt dome. The related in situ, studies in a salt test facility can therefore be divided into six categories: development and test of disposal methods, studies related to the stability of underground openings at ambient temperatures; studies related to all consequences of putting high-level heat generating waste into a salt repository, studies related to the backfilling and sealing of boreholes and of the repository, studies related to failure scenarios, and special studies necessary for operating the test facility. The main test facility in the Federal Republic of Germany is the Asse Salt Mine.

36125 (ONWI—88, pp 98-118) **Geological and hydrological exploration of Gulf Coast Salt Domes.** Laughon, R.B. (Battelle Memorial Inst., Columbus, OH). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The geologic exploration program in the Gulf Coast Salt Dome Region is based on a screening process that includes a series of increasingly detailed studies. The screening procedure takes the following steps: (1) determination of regions for further study (in this case, the salt domes of the interior Gulf Coast); (2) regional surveys and the determination of areas within those regions which are thought to be most suitable and which are recommended for further evaluation (in this case, eight specific salt domes); (3) area characterizations and the determination of locations within the areas which are thought to have a high probability of suitability (in this case, two or three of the eight salt domes); (4) location studies and the determination of a potential repository site, which is thought to be suitable and licensable and which is recommended for completion of site characterization studies (in this case, a single salt dome).

36126 (ONWI—88, pp 119-132) **United States geological exploration and hydrology, Southeastern New Mexico.** Brannen, J.P. (Sandia Labs., Albuquerque, NM). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

This discussion focuses on those features viewed as having a major impact on performance. Those features are potential contributors to a repository breach or are important in the movement of materials to the biosphere. The proposed WIPP site is in southeastern New Mexico in the Delaware Basin, a structural subelement of the Permian Basin. Major siting criteria and factors considered in the Los Medanos studies are outlined.

36127 (ONWI—88, pp 133-155) **German geological exploration and hydrology of Asse II.** Batsche, H.; Klarr, K.; von Stempel, C. (Gesellschaft fuer Srahlen- end Umweltforschung, Clausthal-Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

For the following reasons the Asse II salt mine was acquired by the Gesellschaft fuer Strahlen- und Umweltforschung in 1965 for the disposal of radioactive wastes: the large safety margin observed in shaft 2 towards Asse 1 and the overlying rocks, the nonexistence of Hauptanhydrit anhydrite which was often the cause of groundwater intrusion in salt mines, the fact that the caprock found here is dry. The disposal of radioactive wastes on an experimental basis involved an extensive geological and hydrological exploration of both the salt anticline itself and the overlying rocks. These consist in a multiple succession of jointed and fissured permeable and clayey marly impermeable layers with diagonal and transverse faults.

36128 (ONWI—88, pp 169-185) **Waste isolation safety assessment program WISAP release scenario analysis.** Benson, G.L. (Battelle Pacific Northwest Labs., Richland, WA). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

This paper consists of viewographs which outline the release scenario analysis and disruptive event analysis methodologies for a simulated waste repository over a 10^6 year time frame. (DLC)

36129 (ONWI—88, pp 226-247) **Thermal/mechanical modelling for repository design and in-situ testing.** Gnirk, P.F. (RE/SPEC Inc., Rapid City, SD). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

A thermomechanical model of a radioactive waste repository in a geologic medium is used to evaluate the time and spatial response of the rock mass to repository excavation and emplacement of heat-generating wastes. Modeling results are presented for repository temperature, vertical surface displacements, room closure, canister/rock interface temperatures, etc. (DLC)

36130 (ONWI—88, pp 248-319) **Thermal mechanical modelling.** Langer, M. Delisle, G.; Wallner, M. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

This discussion of thermal and thermo-mechanical effects of a nuclear waste repository onthe host formation (salt concerns itself with the research results gained in Germany since the last US/FRG Workshop in Richland/Wash. Thermal aspects are considered first, followed by a discussion of recent results of investigations dealing with thermo-mechanical effects.

36131 (ONWI—88, pp 325-339) **Summary of convergence and stress measurements in the Temperature-test-field 4.** Duerr, K. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Aim of ongoing convergence measurements in the gallery sides, roof, and floor of Temperature-test-field 4 (TVF 4) will determine the alterations of the rock's physical parameters by the temperature increase. For this purpose wire and rod extensometers have been used. In the boreholes, which will be heated later on, convergence sounds are installed. To know the initial rock-mechanical conditions in the test field extensometer measurements will be necessary before heating.

36132 (ONWI—88, pp 340-345) **Waste isolation pilot plant (WIPP) experimental program.** Hunter, T.O. (Sandia Labs., Albuquerque, NM). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The Waste Isolation Pilot Plant (WIPP) proposed for implementation in southeastern New Mexico provides a facility for the retrievable storage of defense transuranic wastes. WIPP will also include a location for generic experimentation on the interaction of defense wastes and bedded salt. These experiments will include waste forms which have heat and radiation production commensurate with defense high-level wastes (DHLW). Experiments will also be performed with enhanced temperature and radiation conditions which accelerate the interactions of interest. All experiments on DHLW are planned for removal after the experimentation is complete.

36133 (ONWI—88, pp 346-351) **Summary of shaped cavern convergence measurements.** Staudendahl, G. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Preliminary conclusions can be drawn from observation at present: (1) the time dependent wall closure of the cavity and displacements within the surrounding salt stratum in a global sence are running with almost decreasing rates; (2) the long-term deformation and strains accumulated up to now are smaller than anticipated before; (3) the structural safety of this cavity is ensured at present; (4) it could be demonstrated, that the monitoring system installed can be operated successfully as well over a long-term period as under most severe conditions; (5) these observations and in situ experiments are nessessary and suggestive; (6) results and conclusions from these measurements are not only important with regard to this cavity, moreover for other projects at Asse and other sites in comparable salt formations.

36134 (ONWI—88, pp 377-384) **Brine experiments by the BGR in the Asse II.** Kopietz, J. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Objectives of these simple thermomechanical heating experiments in the Asse is to investigate the influence of radioactive heat production on repository integrity. The increase in temperature was accompanied by an increase in the brine level in the boreholes due to borehole convergence caused by the heating. The brine levels in the outer observation boreholes are still rising about one year after turning the heater off. 6 figures. (DLC)

36135 (ONWI—88, pp 385-391) **Asse II in-situ brine migration tests.** Rothfuchs, T. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

For measuring the heat-induced brine inflow into a heater borehole an experimental area in the Older Halite formation on the 750m level of the ASSE II salt mine was selected. In March and April 1978 the mining of the room in preparation for this experiment was completed. Five 2KW - heaters will be placed in the borehole No. 2. These heaters simulate High Active Waste (HAW) and will give data in regard to the thermal, thermal-mechanical and physical-chemical response of the Older Halite Formation by electrical heating.

36136 (ONWI—88, pp 405-416) **Experiments on the corrosion of materials for borehole casings and for waste packaging canister in salt.** Gies, H. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

For the test storage initially planned of HLW-canisters at the Asse salt mine a possibility of safe recovery must be provided. For this purpose the borehole must be cased. To ensure safe operation, suitable corrosion resistant materials must be used for the canister and for the borehole casings. This requires studies providing information about the corrosion resistance of the materials throughout the test storage. The catalogue of requirements to be met by the materials for the canisters and for the boreholes drafted initially has been rediscussed with responsible technical institutions, and in the light of this discussion the corrosion resistance of the materials has been reformulated and the test programme has been expanded.

36137 (ORNL/TM—6987) **Actinide partitioning-transmutation program final report. VII. Long-term risk analysis of the geologic repository.** Logan, S.E.; Conarty, R.L.; Ng, H.S.; Rahal, L.J.; Shirley, C.G. (Los Alamos Technical Associates, Inc., NM (USA)). Sep 1980. Contract W-7405-ENG-26. 130p. NTIS, PC A07/MF A01.

This report supports the overall assessment by Oak Ridge National Laboratory of actinide partitioning and transmutation by providing an analysis of the long-term risks associated with the terminal storage of wastes from a fuel cycle which incorporates partitioning and transmutation (P-T) and wastes from a cycle which does not. The system model and associated computer code, called AMRAW (Assessment Method for Radioactive Waste), are used for the analysis and are applied to the Los Medanos area in southeastern New Mexico. Because a conservative approach is used throughout, calculated results are believed to be consistently higher than reasonable expectations from actual disruptive incidents at the site and therefore are not directly suited for comparison with other analyses of the particular geologic location. The assessment is made with (1) the probabilistic, or risk, mode that uses combinations of reasonable possible release incidents with their probability of occurrence distributed and applied throughout the assessment period, and (2) the consequence mode that forces discrete release events to occur at specific times. An assessment period of 1 million years is used. The principal results are: (1) In all but the expulsive modes, ^{99}Tc and ^{129}I completely dominate cumulative effects based on their transport to man through leaching and movement with groundwater, effecting about 33,000 health effects (deaths) over the 1 million years; (2) P-T has only limited effectiveness in reducing long-term risk from a radionuclide waste repository under the conditions studied, and such effectiveness is essentially confined to the extremely unlikely (probability of occurrence 10^{-12}/year) expulsive events; (3) Removal or immobilization of ^{99}Tc and ^{129}I might provide benefits sufficiently tangible to warrant special consideration.

36138 (PNL—2563) **Organic components of nuclear wastes and their potential for altering radionuclide distribution when released to soil.** McFadden, K.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01.

Normal waste processing at the Hanford operations requires the use of many organic materials, chiefly in the form of complexing agents and diluents. These organic materials and their chemical and radiolytic degradation products, have potential for complexing fission products and transuranium elements, both in the waste streams and upon infiltration into soil, perhaps influencing future sorption or migration of the nuclides. Particular complexation characteristics of various nuclides which constitute the major fission products, long-lived isotopes, and the most mobile in radioactive wastes are discussed briefly with regards to their anticipated sorption or mobility in soils. Included in the discussion are Am, Sb, Ce, Cs, Co, Cm, Eu, I, Np, Pm, Pu, Ra, Ru, Sr, Tc, U, and Zr. 107 references.

36139 (PNL—3398) **Assessment of effectiveness of geologic isolation systems: a short description of the AEGIS approach.** Silviera, D.J.; Harwell, M.A.; Napier, B.A.; Zellmer, J.T.; Benson, G.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01.

To meet licensing criteria and protection standards for HLW disposal, research programs are in progress to determine acceptable waste forms, canisters, backfill materials for the repository, and geological formations. Methods must be developed to evaluate the effectiveness of the total system. To meet this need, methods are being developed to assess the long-term effectiveness of isolating nuclear wastes in geologic formations. This work was started in 1976 in the Waste Isolation Safety Assessment Program (WISAP) and continues in the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program. The evaluation of this long-term effectiveness involves a number of distinct steps. AEGIS currently has the methods for performing these evaluation steps. These methods are continuously being improved to meet the inreasing level of sophistication which will be required. AEGIS develops a conceptual description of the geologic systems and uses computer models to simulate the existing ground-water pathways. AEGIS also uses a team of consulting experts, with the assistance of a computer model of the geologic processes, to develop and evaluate plausible release scenarios. Then other AEGIS computer models are used to simulate the transport of radionuclides to the surface and the resultant radiation doses to individuals and populations. (DLC)

36140 (RHO-SA—160) **Heat transfer analysis of the geologic disposal of spent fuel and high-level waste storage canisters.** Allen, G.K. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Aug 1980. Contract AC06-77RL01030. 47p. (CONF-801102—28). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Near-field temperatures resulting from the storage of high-level waste canisters and spent unreprocessed fuel assembly canisters in geologic formations were determined. Preliminary design of the repository was modeled for a heat transfer computer code, HEATING5, which used the Crank-Nicolson finite difference method to evaluate transient heat transfer. The heat transfer system was evaluated with several two- and three-dimensional models which transfer heat by a combination of conduction, natural convention, and radi-

ation. Physical properties of the materials in the model were based upon experimental values for the various geologic formations. The effects of canister spacing, fuel age, and use of an overpack were studied for the analysis of the spent fuel canisters; salt, granite, and basalt were considered as the storage media for spent fuel canisters. The effects of canister diameter and use of an overpack were studied for the analysis of the high-level waste canisters; salt was considered as the only storage media for high-level waste canisters. Results of the studies on spent fuel assembly canisters showed that the canisters could be stored in salt formations with a maximum heat loading of 134 kw/acre without exceeding the temperature limits set for salt stability. The use of an overpack had little effect on the peak canister temperatures. When the total heat load per acre decreased, the peak temperatures reached in the geologic formations decreased; however, the time to reach the peak temperatures increased. Results of the studies on high-level waste canisters showed that an increased canister diameter will increase the canister interior temperatures considerably; at a constant areal heat loading, a 381 mm diameter canister reached almost a 50°C higher temperature than a 305 mm diameter canister. An overpacked canister caused almost a 30°C temperature rise in either case.

36141 (SAND—80-0039) **Analytic solutions for thermal conduction from heat producing cylinders and spheres.** Gartling, D.K. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 39p. PC A03/MF A01.

Solution methods are developed to determine the temperature fields surrounding time dependent, cylindrical or spherical heat sources located in an infinite or semi-infinite medium. The method of superposition is employed to extend the single source solutions to the case of multiple heat sources. Numerical procedures are developed to efficiently evaluate the integral heat source solutions. Two computer programs based on the solution procedure are described. Complete user instructions and example problems for these programs are presented.

36142 (SAND—80-0426C) **Thermal convection at low Rayleigh number from concentrated sources in porous media.** Hickox, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 29p. (CONF-801102—9). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A simple mathematical theory is proposed for the analysis of natural convective motion, at low Rayleigh number, from a concentrated source of heat in a fluid-saturated porous medium. The theory consists of retaining only the leading terms of series expansions of the dependent variables in terms of the Rayleigh number, is thus linear, and is valid only in the limit of small Rayleigh number. Based on fundamental results for a variety of isolated sources, superposition is used to provide solutions for situations of practical interest. Special emphasis is given to the analysis of sub-seabed disposal of nuclear waste. 8 figures.

36143 (SAND—80-1616C) **Stored energy of gamma-irradiated 97% pure rocksalt.** Moss, M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-801102—21). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Samples of 97% pure NaCl from the Waste Isolation Pilot Plant (WIPP) site near Carlsbad, New Mexico, were exposed at 363°K to gamma radiation from a ^{60}Co source, and annealed at constant rates of heating in a differential scanning calorimeter in order to release the stored energy. Radiation doses were 2.2, 5.4, 8.2, 11, and 13 x 10^9 rad, and temperature scans were conducted from room temperature to 800°K. The stored energy-dose relationship is best described empirically by $\ln Q_0$(kJ/kg) = (-39.2 -+ 2.6) + (1.84 +- 0.12) lnD(rad). Temperature scans of 0.17, 0.33, 0.67, and 1.33 K/s were performed to determine the activation energy E of the annealing process. For the four most highly irradiated samples, E = 113 +- 31 kJ/mol. The values of stored energy and activation energy for the annealing process are similar to those reported by previous investigators. These data, then, support their conclusion that there appears to be no danger of a rapid release of the stored energy in a nuclear waste respository of bedded salt, nor could serious consequences result from such a release by some unforeseen mechanism.

36144 (UCID—18678) **Waste form dissolution in bedded salt.** Kaufman, A.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1980. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

A model was devised for waste dissolution in bedded salt, a hydrologically tight medium. For a typical Spent UnReprocessed Fuel (SURF) emplacement, the dissolution rate wll be diffusion limited and will rise to a steady state value after t/sub eq/ ≈ 250 $(1+(1-\epsilon_0)$ K/sub D//$\epsilon_0)$ (years) ϵ_0 is the overpack porosity and K/sub d/ is the overpack sorption coefficient. The steady state dissolution rate itself is dominated by the solubility of UO_2. Steady state rates between 5 x 10^{-5} and .5 (g/year) are achievable by SURF emplacements in bedded salt without overpack, and rates between 5 x 10^{-7} and 5 x 10^{-3} (g/year) with an overpack having porosity of 10^{-2}.

36145 (UCID—18796-80-1) **Waste Isolation Program Evaluation Assistance. Quarterly technical progress report.** Maninger, R.C.; Harvey, T.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1980. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01.

This report covers the effort for the first quarter on the Waste Isolation Program Evaluation Assistance Project at LLNL. The basic principles of a method of portraying the National Waste Terminal Storage Program are outlined and an example of their applcations is given.

36146 (UCRL—81147(Pt.2)(Rev.1)) **Leaching characteristics of actinides from simulated reactor waste.** Weed, H.C.; Coles, D.G.; Bradley, D.J.; Mensing, R.W.; Schweiger, J.S.; Rego, J.H. (Battelle Pacific Northwest Labs., Richland, WA (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 9p. (CONF-791112—69(Pt.2)(Rev.1)). NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Leach rates for ^{237}Np and ^{239}Pu are investigated with a single-pass leaching system. The factorial experimental design uses several combinations of solution composition and flow rate; and two temperatures, 25° and 75°C. The 25°C results are compared with those form a modified IAEA procedure. At 25°C, leach rates decrease with time. Agreement between results from the single-pass and modified IAEA methods is fair with WIPP brine leachant, good with $NaHCO_3$, and good with distilled H_2O. Leach rates are approximately independent of flow rates at room temperature, but increase with flow rates at high temperature. Rates for ^{237}Np increase with temperature, but those fro ^{239}Pu either decrease or do not change with temperature.

36147 (USGS-OFR—79-1675) **Fluid inclusions in salt from the Rayburn and Vacherie domes, Louisiana.** Roedder, E.; Belkin, H.E. (Geological Survey, Washington, DC (USA)). 1979. 25p. NTIS, PC A02/MF A01.

Core samples from the Rayburn and Vacherie salt domes in Louisiana were examined for fluid inclusions, in connection with the possible use of such domes for nuclear waste storage sites. Three types of fluid inclusions were found: brine, compressed gas, and oil (in decreasing volume percent abundance). The total amount of such fluids is small, certainly < 0.01 vol % and probably in the range 0.1 to 0.001 volume %, but the inclusions are highly erratic in distribution. Unlike many bedded salt deposits, the brine inclusions in this salt contain fluids that are not far from simple NaCl-H_2O solutions, with very little of other ions. One of three possible explanations for such fluids is that fresh water penetrated the salt at some unknown time in the past and was trapped; if such entry of fresh water has occurred in the past, it might also occur again in the future.

36148 (USGS-OFR—80-941) **Interpretation of geophysical well-log measurements in drill hole UE25a-1, Nevada Test Site, Radioactive Waste Program.** Hagstrum, J.T.; Daniels, J.J.; Scott, J.H. (Geological Survey, Las Vegas, NV (USA)). 1980. Contract AI08-78ET44802. 36p. NTIS, PC A03/MF A01.

An exploratory hole (UE25a-1) was drilled at Nevada Test Site (NTS) to determine the suitability of pyroclastic deposits as storage sites for radioactive waste. Studies have been conducted to investigate the stratigraphy, structure, mineralogy, petrology, and physical properties of the tuff units encountered in the drill hole. This report deals with the interpretation of physical properties for the tuff units from geophysical well-log measurements. The ash-flow and bedded tuff sequences at NTS comprise complex lithologies of variously welded tuffs with superimposed crystallization and altered zones. To characterize these units, resistivity, density, neutron, gamma-ray, induced polarization, and magnetic susceptibility geophysical well-log measurements were made. Although inherently subjective, a consistent interpretation of the well-log measurements was facilitated by a computer program designed to interpret well logs either individually or simultaneously. The broad features of the welded tuff units are readily distinguished by the geophysical well-log measurements. However, many details revealed by the logs indicate that more work is necessary to clarify the casual elements of well-log response in welded tuffs.

36149 **Disposal of iodine-129.** Morgan, M.T.; Moore, J.G.; Devaney, H.E.; Rogers, G.C.; Williams, C.; Newman, E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. pp 453-459 of Scientific basis for nuclear waste management. Volume 1. McCarthy, G.J. (ed.). New York, NY; Plenum Publishing Corporation (1979).

One of the problems to be solved in the nuclear waste management field is the disposal of radioactive iodine-129. This

nuclide is one of the more volatile and long-lived fission products. Studies at ORNL have shown that fission products can be fixed in concrete for permanent disposal. Current studies have demonstrated that practical cementitious grouts may contain up to 18% iodine as barium iodate. The waste disposal criterion is based on the fact that harmful effects to present or future generations can be avoided by isolation and/or dilution. Long-term isolation is effective in deep, dry repositories; however, since penetration by water is possible, although unlikely, release was calculated based on leach rates into water. Further considerations have indicated that sea disposal on or in the ocean floor may be a more acceptable alternative.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 36046, 36107, 36116, 36137, 36146

36150 (GAT-T—2975) **Survey of asbestos fibers in cooling tower waters at Goodyear Atomic Corporation.** Riepenhoff, D.L.; Boyd, D.E. (Goodyear Atomic Corp., Piketon, OH (USA)). 1 Nov 1979. Contract AC05-76OR00001. 14p. NTIS, PC A02/MF A01.

Monitoring of the recirculating water (RCW) system at Goodyear Atomic Corporation has been performed since late 1975, when detectable amounts of asbestos were found in the RCW. From August 1976 through may 1979, fiber counts varied from below detectable limits (0.7 x 10^6 fibers/liter) to 16.2 x 10^6 fibers/liter in the cooling tower water. These results were nearly identical to the initial asbestos fiber data obtained for RCW from December 1975 through July 1976. From January 1977 through May 1979, water samples from the X-616 Chromate Recovery Facility effluent and the X-611 Water Treatment Plant (RCW makeup) were also analyzed for asbestos, and fiber counts varied from below detectable limits to 0.7 x 10^6 fibers; liter and 1.4 x 10^6 fibers/liter, respectively. The number of fibers in the RCW system and at the X-611 and X-616 facilities does not present an environmental problem at this time. Beginning in June 1978, all samples collected were prepared for analysis by two methods after a United States Environmental Protection Agency-sponsored study demonstrated that a method different from the one used at Goodyear Atomic Corporation had essentially zero fiber losses. To date, no significant differences have been observed between the two methods. In the future, monitoring of asbestos fibers should continue on a periodic basis to determine if an asbestos fiber problem develops.Both methods of sample preparation should be utilized to firmly establish which method is best.

36151 (ONWI—88, pp 186-196) **PSE: release scenario analysis.** Storck, R. (Technische Universitaet, Berlin, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The Project Safetystudies Entsorgung (PSE) is concerned with risk type analysis of engineered and geological systems. A generalized method has been developed which is applicable to both. The essential element of this method is the so-called release tree. This paper presents a short description of the general method and shows its application to the final repository. During execution of the analysis, many difficulties arose, especially in the understanding of some physical processes. These difficulties are mentioned and will be subject to detailed investigation in the future.

36152 (ONWI—88, pp 197-212) **General modeling, considerations and data requirements for consequence analysis.** Memmert, G. (Technische Universitaet, Berlin, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Within the PSE (Safety-Studies-Entsorgung), theoretical hydrological investigations are being conducted of the flow of ground water above and around a salt dome and of the transport of contaminants by the water. (DLC)

36153 (ONWI—88, pp 213-225) **Release consequence analysis.** Pahwa, S. (Intera Environmental Consultants Inc., Houston, TX). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

This paper outlines the steps involved in hydrology and contaminant transport modeling, approaches within various waste management programs, modeling strategies, data needs, strength/limitations of model types, model development needs, and validation an crosschecking. (DLC)

36154 (PNL-SA—8571(Vol.2)) **Waste Isolation Safety Assessment Program. Task 4. Third Contractor Information Meeting .** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 392p. (CONF-7910160—(Vol.2)). NTIS, PC A17/MF A01.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

The study subject of this meeting was the adsorption and desorption of radionuclides on geologic media under repository conditions. This volume contans eight papers. Separate abstracts were prepared for all eight papers. (DLC)

36155 (PNL-SA—8571(Vol.2), pp 1-79) **Systematic study of nuclide adsorption on selected geologic media. Annual progress report, October 1, 1978-September 17, 1979.** Meyer, R.E. (comp.). (Oak Ridge National Lab., TN). Jun 1980.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

This report summarizes the past year's work concerning the adsorption of nuclides of interest to nuclear waste on clays, hydrous oxides, and other geologic media as a function of the pertinent variables of salt concentration, pH, and loading. Most of the adsorbent-adsorbate systems were investigated in the pH range 5 to 10 and the salt concentration range from 0.01 to 5 M NaCl in order to cover the most probable compositions of groundwaters in the region of waste repositories located in bedded salt formations or salt domes. A batch method was generally used to obtain the data, but for some special conditions, the axial filter was used. For adsorption on clay minerals at pH values of about 5 where hydrolysis reactions are not likely to occur, a strong salt dependence was observed, and the data could be fairly well described by ideal ion exchange equations. As the pH was increased, for some of the systems, e.g. for Eu(III) adsorption on montmorillonite, distribution coefficients increased significantly with pH and the salt dependence decreased or disappeared entirely. For adsorption of Sr(II) and Eu(III) on hydrous oxides, usually a form of Al_2O_3, significant increases in distribution coefficients with pH were observed and the salt dependence was very small, but often increasing somewhat as the pH was increased. Distribution coefficients for adsorption of I^- on a large variety of minerals and rocks were almost always very small, generally almost zero, and only for a few adsorbents under special conditions were distribution coefficients as high as 10 liters/kilogram observed. These results demonstrate that a large number of experiments are required for a complete and systematic investigation of a single nuclide-adsorbent system but also show that the dependence of the distribution coefficient on the variables show regularities which may be used to interpolate and extrapolate the data to nontested conditions.

36156 (PNL-SA—8571(Vol.2), pp 235-260) **Waste/rock interaction technology. Solubility of plutonium compounds and their behavior in soils.** Rai, D.; Serne, R.J.; Moore, D.A. (Pacific Northwest Labs., Richland, WA). 1 Feb 1980.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

The solubilities of $^{239}PuO_2$(c) and $^{239}Pu(OH)_4$(am) under natural environmental conditions were determined. These data were then used to predict the (1) nature of the solid phases present in contaminated soils, and (2) total concentration of Pu that can be expected in soil solutions when these Pu solids are present. Based upon solubility measurements, an estimated value of the log K/sup c/ for the dissolution of $^{239}PuO_2$(c) [PuO_2(c) reversible $PuO_2 + e^-$] was found to be -14.8. The estimated value of the log K/sup c/ for the dissolution of $^{239}Pu(OH)_4$(am) [$Pu(OH)_4$(am) reversible $PuO_2 + 2\,H_2O + e^-$] was found to be -12.8. Comparison of Pu concentration in equilibrium solutions of contaminated Hanford soils with the PuO_2(c) and $Pu(OH)_4$(am) solubility lines suggested that $Pu(OH)_4$(am) was absent from all the samples and that two of the samples contained PuO_2(c). The presence of PuO_2(c) was also confirmed by X-ray diffraction of Pu particles isolated from one of the samples.

36157 (PNL-SA—8571(Vol.2), pp 213-234) **Waste/rock interactions technology. Interactions of plutonyl (VI) with soil minerals.** Rai, D.; Serne, R.J.; Moore, D.A. (Pacific Northwest Labs., Richland, WA). Feb 1980.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Plutonium-239 adsorption by differnt minerals from aerated 0.005 M $CaCl_2$ solutions containing 7.3 x 10^{-9} M Pu(VI) was studied. At pH 4, adsorption by the selected minerals differed significantly, with adsorption increasing in the following order: gibbsite < kaolinite < montmorillonite < nontronite ≅ hematite < vermiculite ≅ biotite. At pH 7, the adsorption on these minerals did not differ significantly and exceeded 93% in all cases. Several mechanisms that contributed to Pu adsorption were identified: ion exchange, specific adsorption, reduction of Pu(VI), and Pu(VI) hydrolysis. Vermiculite, biotite, and hematite, containing structural Fe(II), were found to reduce Pu(VI) even in the well aerated suspensions. Although the initial ^{239}Pu concentration added to the mineral suspensions was 22 times the MPC of ^{239}Pu in unregulated water, the concentration in equilibrated solutions at pH 7 were near or lower than the MPC. This was also true for vermiculite, biotite, and hematite at pH 4. A very small percentage of the adsorbed Pu was released when the

minerals were contacted with 1 M NaCl. These results indicate that Pu in general and Pu(VI) specifically would be relatively immobile in geomedia that do not contain significant quantities of complexing ligands.

36158 (PNL-SA—8571(Vol.2), pp 81-133) **Sorption-desorption of long-lived radionuclide species on geologic media. Annual report.** Francis, C.W.; Bondietti, E.A. (Oak Ridge National Lab., TN). 1 Oct 1979.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Influence of time, temperature, pH, Eh, Fe^{+2}, and Tc concentrations on sorption-desorption of Tc on basalt, granite, and shale was investigated. Loss of TcO^{-}_{4} from solution appears not to be due to sorption, but rather due to the reduction to a lower oxidation state, probably TcO_2 which is insoluble. Loss of TcO^{-}_{4} increased with time. Increasing the temperature enhanced the initial reduction rate, but the rate exponentially decayed at high temperatures (72 vs 22°C). Basalt reduced TcO^{-}_{4} faster and in greater quantities than the granite or shale samples. 10^6 more Tc-99 was retained on anoxic basalt columns than Tc-95m; however, the Sorption Concentration Ratios (0.64 and 3.54 ml/9) were not appreciably different. The additions of Fe^{+2} prior to TcO^{-}_{4} additions did not affect TcO^{-}_{4} reduction; but, additions of Fe^{+2} to Tc-rock suspensions reduced TcO^{-}_{4}. The reduced form of Tc is slowly oxidized to the TcO^{-}_{4} under oxic conditions. In Eh-pH monitored stirred suspensions, the sngle most important variable influencing the loss of TcO^{-}_{4} was Eh of the suspension. Losses of TcO^{-}_{4} from basalt suspensions occurred at measured Eh's 0.240 volts higher than theoretically required for the formation of the water-insoluble TcO_2. Pertechnetate (μM) was observed to be stable in the presence of 100 μM Fe^{+2}, pH 5, and Eh ~ +0.400 volts; even at Fe^{+2}/TcO^{-}_{4} ratios > 10^6, the pertechnetate was observed to be stable at pH's between 4.5 and 5.5. As the pH was increased to 6.5 and greater the loss of TcO^{-}_{4} from solution was directly proportional to the loss of Fe^{+2}. TcO^{-}_{4} was reduced by Fe^{+2} as the pH was increased, and Tc^{+4} was isomorphically substituted into the lattice of $Fe(OH)_3$ because of the similarity in ionic radii (0.65 A) of Tc^{+4} and Fe^{+3}.

36159 (PNL-SA—8571(Vol.2), pp 135-158) **Laboratory studies of Pu-237 sorption on selected minerals under anoxic conditions.** Relyea, J.F.; Serne, R.J.; Fulton, R.W.; Washburne, C.D.; Martin, W.J. (Pacific Northwest Lab., Richland, WA). 1 Oct 1979.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Corrections have been made for measured Kd values for plutonium under anoxic conditions after 30 days of shaking. Values for Kd(Pu) were highest for the phyllosilicate minerals illite, montmorillonite, vermiculite and biotite. Corrected Kd/sub a/(Pu) values were generally higher under anoxic than ambient atmospheric conditions in both 5.13 N NaCl and 0.03 N $CaCl_2$. Lower values for Kd/sub a/(Pu) were observed in 0.03 N $NaHCO_3$ under anoxic than under ambient conditions. There were no statistically significant differences in Kd/sub a/(Pu) for the two oxygen conditions for the 0.03 N NaCl solution. Thermodynamic data suggest that Pu sorption would be greater under anoxic conditions as shown in two of the four solutions used. There is no explanation for the apparent lack of agreement of the other two solutions. In general Pu adsorption by the minerals was high with the lowest mean value for corrected data being Kd/sub a/(Pu) = 92 for quartz under anoxic conditions. Of the 96 permutations (12 minerals x 4 solutions x 2 oxygen conditions) in only 14 instances did the Kd/sub a/(Pu) fall below 1000 ml/g and in only 5 instances did Kd/sub a/(Pu) fall below 500 ml/g.

36160 (PNL-SA—8571(Vol.2), pp 261-315) **Kinetics and reversibility of radionuclide sorption reactions with rocks. Progress report for fiscal year 1979.** Barney, G.S.; Brown, G.E. (Rockwell International, Richland, WA). Sep 1979.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Sorption-desorption reactions of cesium, strontium, neptunium, americium, and plutonium on basalt, granite, and argillite were observed for 218 days. Equilibrium in batch experiments was not reached for most radionuclides even after this long time. Reactions of the crushed rock with ground waters (dissolution, hydrolysis, precipitation, etc.) also did not reach equilibrium after 150 days. The dissolution of basalt is accompanied by the formation of colloidal particles which contain Si, Fe, Ca, and Al. These colloids sorb Cs, Sr, Am, and Pu during equilibration. Some of the colloids pass through 0.3-μm filters, are not retained even on 0.01-μm filters and, therefore, cause calculated K/sub d/ values to be too low. Samples of crushed basalt, granite, and argillite were artificially weathered by continuous leaching with distilled water for 6 months both in air and in an oxygen-free stream of nitrogen gas. The weathered rock was then characterized for surface area, surface structure, cation exchange capacity, and composition of weathered surface on the rock. Comparisons were made of radionuclide sorption (after 14 days) on fresh rock, rock weathered in air, and rock weathered in N_2. Sorption on rocks weathered in N_2 generally is less than on rock weathered in air. This is possibly due to the lack of an $Fe(OH)_3$ coating on the rock weathered in N_2. The $Fe(OH)_3$ is known to scavenge cations and silica from solution. Sorption of Cs, Si, Am, and Pu is strongly affected by weathering basalt and argillite. However, the cation exchange capacity is changed very little, suggesting that ion exchange plays a minor role in sorption of these radionuclides.

36161 (PNL-SA—8571(Vol.2), pp 159-171) **Effects of hydrogen peroxide pretreatment of clay minerals on the adsorption of Sr-85 and Tc-95m under anoxic conditions.** Relyea, J.F.; Washburne, C.D. (Pacific Northwest Lab., Richland, WA). Jul 1979.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Treatment of three clay minerals with hydrogen peroxide affects the observed adsorption behavior of technetium relative to untreated clay under anoxic conditions. A possible adsorption mechanism of Tc is the reduction of TcO^{-}_{4} to a more positively charged or better adsorbed species. Oxidation of the clay by H_2O_2 would hinder the reduction of TcO^{-}_{4} by buffering the clay-water system at a higher Eh value, although a difference in measured Eh value may go undetected. Sorption of strontium by the clays under the same conditions is not affected by a pretreatment with H_2O_2. The behavior of strontium follows that expected from ion exchange theory. 13 tables.

36162 (PNL-SA—8571(Vol.2), pp 173-211) **Sorption behavior of ^{85}Sr, ^{137}Cs and /sup 95m/Tc under normal atmospheric and reduced oxygen levels.** Relyea, J.F.; Washburne, C.D.; Fulton, R.W. (Pacific Northwest Lab., Richland, WA). Jul 1979.

From 3. contractor information meeting on waste isolation safety assessment program task 4; Seattle, WA, USA (14 Oct 1979).

Identical mineral samples and simulated groundwaters were used in a study of the sorption of technetium, strontium and cesium under anoxic conditions. Results from these experiments show that the anoxic sorption of strontium and cesium is generally unchanged or lower than sorption under ambient atmospheric conditions. The sorption of both Cs and Sr is inhibited by the presence of high NaCl concentrations (brines), and Sr sorption is reduced by the presence of Ca^{2+} in solution. Values for Kd(Cs) and Kd(Sr) often change with time, as both the mineral properties and solution chemical composition change due to weathering of the minerals. In these instances equilibrium has not been attained; differences between ambient and anoxic Kd values found at short contact times may disappear at equilibrium. Both Kd values and their variability were increased for technetium under anoxic conditions. Technetium adsorption is greatest on the hard rock minerals (tektosilicates and inosilicates) which may be influenced by small chunks of metal from the apparatus used to grind the minerals to power form. 21 tables.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 36074, 36091, 36092, 36094, 36108, 36109, 36121, 36128, 37214, 37358

36163 (CONF-800943—(Summ.), pp 121-123) **Identification of potential safety-related incidents applicable to a breeder fuel reprocessing plant.** Perkins, W.C. (Savannah River Lab., Aiken, SC). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36164 (UCID—17930) **Meteorology and demography models for risk assessments of accidental atmospheric releases of nuclear waste. Phase 2 methodology.** Peterson, K.R.; Harvey, T.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract W-7405-ENG-48. 20p. NTIS, PC A02/MF A01.

Models are derived for determining the risk of release to the atmosphere of radioactive materials during nuclear waste handling. Such releases might occur in three phases of the nuclear waste handling cycle: (1) at fuel reprocessing plants during handling and interim storage, (2) during transportation to a permanent storage area, or (3) at the permanent disposal area (federal waste repository). Gaussian diffusion equations for both plume- and puff-type releases are used with demographic models to assess relative integrated population doses. Given a unit release and assuming an equal accident probability, we conclude that the largest risk would be from a transportation accident in a metropolitan area. The effect of a release during transportation in a rural area or at a fuel reprocessing plant would be one to two orders of magnitude less, while at a federal waste repository the population dose would be three or more orders of magnitude less than for the metropolitan transportation accident.

36165 (UCID—18781) **Fire protection countermeasures for containment ventilation systems.** Alvares, N.; Beason, D.; Bergman, V.; Creighton, J.; Ford, H.; Lipska, A. (Sandia National Labs., Albuquerque, NM (USA)). 25 Aug 1980. Contract W-7405-ENG-48. 190p. NTIS, PC A09/MF A01.

The goal of this project is to find countermeasures to protect High Efficiency Particulate Air (HEPA) filters, in exit ventilation ducts, from the heat and smoke generated by fire. Initially, methods were developed to cool fire-heated air by fine water spray upstream of the filters. It was recognized that smoke aerosol exposure to HEPA filters could also cause disruption of the containment system. Through testing and analysis, several methods to partially mitigate the smoke exposure to the HEPA filters were identified. A continuous, movable, high-efficiency prefilter using modified commercial equipment was designed. The technique is capable of protecting HEPA filters over the total time duration of the test fires. The reason for success involved the modification of the prefiltration media. Commercially available filter media has particle sorption efficiency that is inversely proportional to media strength. To achieve properties of both efficiency and strength, rolling filter media were laminated with the desired properties. The approach was Edisonian, but truncation in short order to a combination of prefilters was effective. The application of this technique was qualified, since it is of use only to protect HEPA filters from fire-generated smoke aerosols. It is not believed that this technique is cost effective in the total spectrum of containment systems, especially if standard fire protection systems are available in the space. But in areas of high-fire risk, where the potential fuel load is large and ignition sources are plentiful, the complication of a rolling prefilter in exit ventilation ducts to protect HEPA filters from smoke aerosols is definitely justified.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 36057, 36070, 36649, 36970

36166 Calorimetric systems designed for in-field non-destructive assay of plutonium-bearing materials. Roche, C.T.; Perry, R.B.; Lewis, R.N.; Jung, E.A.; Haumann, J.R. (Argonne National Lab., IL (USA)). pp 137-146 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Calorimetric assay provides a precise non-destructive analytical (NDA) method for determining sample plutonium content based on the heat emitted by decaying radionuclides. Calorimetry has a plutonium-detection sensitivity of 20 ppm, and power measurement precision better than 0.1% is obtainable. It is insensitive to the chemical form of the plutonium and is independent of measurement-bias problems due to sample geometric configuration and sample matrix composition. Also, the ability of an operator to calibrate a calorimeter using electrical-heat standards eliminates the necessity of transporting plutonium calibration sources. These considerations make calorimetry an important assay tool which can be used by itself or for calibrating more rapid, but less accurate, NDA techniques. The total plutonium mass of the sample may be obtained nondestructively by combining the calorimetric power measurement with a gamma-spectrometer analysis of the sample isotopic content. Conventional calorimetric design measures the temperature rise of a plutonium-containing sample chamber in contact with a large water-bath heat sink. This design lacks the mobility needed by inspection personnel. The Argonne National Laboratory (ANL) air-chamber isothermal calorimeters are low-thermal capacitance devices which eliminate the need for large, constant-temperature heat sinks. A bulk calorimeter designed to measure sealed containers holding up to 3 kg Pu, and a small-sample calorimeter designed to measure mixed-oxide fuel pellets and powders are discussed. The operational characteristics of these instruments are described, and the results of sample assays presented.

36167 (CONF-800460—5) **Quantitative differential thermal analysis study of the U_3O_8-Al thermite reaction.** Pasto, A.E.; Copeland, G.L.; Martin, M.M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From 82. annual American Ceramic Society meeting; Chicago, IL, USA (27 Apr 1980).

Concerns about proliferation resistance of nuclear fuel cycles and fuels have prompted a reinvestigation of U_3O_8-Al cermet fuels currently being used in research and test reactors. In particular, higher loadings of U_3O_8 are being considered. These new fuel compositions are in the region of maximum possible thermal energy release from the high-temperature thermite reaction between the U_3O_8 and aluminum components. This study was initiated to quantitatively measure the amount of reaction heat evolved. A differential thermal analysis system was calibrated with materials of known heat of reaction. Subsequently, specimens of high-uranium-loaded U_3O_8-Al powder mixtures were analyzed. Thermite reaction heat measured for these specimens was much lower than expected. Specimens of simulated fuel plates showed similar low results. Possible reasons for this behavior are discussed.

36168 (CONF-800655—33(Draft)) **Implementation of the Facility Integrated Inventory Computer System (FICS).** McEvers, J.A.; Krichinsky, A.M.; Layman, L.R.; Dunnigan, T.H.; Tuft, R.M.; Murray, W.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

This paper describes a computer system which has been developed for nuclear material accountability and implemented in an active radiochemical processing plant involving remote operations. The system posesses the following features: comprehensive, timely records of the location and quantities of special nuclear materials; automatically updated book inventory files on the plant and subplant levels of detail; material transfer coordination and cataloging; automatic inventory estimation; sample transaction coordination and cataloging; automatic on-line volume determination, limit checking, and alarming; extensive information retrieval capabilities; and terminal access and application software monitoring and logging.

36169 (CONF-800943—(Summ.), pp 140-141) **An operational facility-integrated computer system for safeguards.** Armento, W.J.; Brooksbank, R.E.; Krichinsky, A.M. (Oak Ridge Natl. Lab., TN). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36170 (CONF-800943—(Summ.), pp 142-144) **Applications of nondestructive assay instrumentation to reprocessing plant safeguards.** Hsue, S.-T.; Russo, P.A. (Los Alamos Scientific Lab., NM). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36171 (CONF-800943—(Summ.), pp 145-146) **Nondestructive measurements on spent fuel for away-from-reactor storage facilities.** Phillips, J.R.; Cobb, D.D. (Los Alamos, scientific Lab., NM). 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36172 (CONF-800943—(Summ.), pp 147-150) **Physical protection concepts for facility design .** Darby, J.L. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

36173 Development, test and evaluation programme for dynamic nuclear materials control. Augustson, R.H.; Baron, N.; Ford, R.F. (Los Alamos Scientific Lab., NM (USA)) (and others). pp 445-460 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

A significant part of the Los Alamos Scientific Laboratory Safeguards Program is directed towards the development, test, and evaluation of dynamic nuclear materials control. The building chosen for the prototype system is the new Plutonium Processing Facility in Los Alamos, which houses operations such as metal-to-oxide conversion, fuel pellet fabrication, and scrap recovery. A DYnamic MAterials Control (DYMAC) system is currently being installed in the facility as an integral part of the processing operation. DYMAC is structured around interlocking unit-process accounting areas. It relies heavily on automatic non-destructive assay measurements made in the process line to draw dynamic material balances in near real time. In conjunction with the non-destructive assay instrumentation, process operators use interactive terminals to transmit additional accounting and process information to a dedicated computer. The computer verifies and organizes the incoming data, immediately updates the inventory records, monitors material in transit using elapsed time, and alerts the nuclear materials officer in the event that material balances exceed the predetermined action limits. The DYMAC system comes within the jurisdiction of the United States safeguards programme, and is under control of the facility operator. The system's advanced features will oblige the IAEA to upgrade its inspection capability. The central issue is how the IAEA can make use of the system's features yet maintain independent verification. This is the subject of a current study sponsored by the US-IAEA Technical Assistance Programme.

36174 Portable neutron coincidence counter for assaying large plutonium samples. Krick, M.S.; Evans, M.L.; Ensslin, N.; Hatcher, C.; Menlove, H.O.; Sapir, J.L.; Swansen, J.E. (Los Alamos Scientific Lab., NM (USA)); De Carolis, M.; Ramalho, A. (International Atomic Energy Agency, Vienna (Austria)). pp 51-63 of Nuclear safeguards technology, 1978. Vol. 2. Vienna, Austria; IAEA (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

A portable high-level neutron coincidence counter (HLNCC) has been developed at the Los Alamos Scientific Laboratory (LASL) for the assay of plutonium by inspectors of the International Atomic Energy Agency (IAEA). The counter is designed to measure the effective ^{240}Pu mass in plutonium samples which may have a

high plutonium content. The term "high-level" refers to the high neutron count-rates produced by large (several kilograms) PuO_2 or plutonium metal samples. The counter measures coincident fission neutrons in the presence of a random neutron background. Total plutonium content is calculated from the plutonium isotopic composition. Correction procedures for removing non-linearities in the counter response due to multiplication effects in the samples are being developed for plutonium metal and PuO_2 samples. The detector consists of 18 ^3He proportional counters embedded in six polyethylene slabs, which form an hexagonal well. Top and bottom endplugs can be used to form a closed sample-counting cavity. The detector weighs approximately 35 kg. A portable electronics package featuring shift-register coincidence counting electronics was designed for use with the detector; it includes all the electronic subsystems required for the operation of the counter except for the preamplifiers, which are mounted on the side of the detector. The electronics package is interfaced to a Hewlett-Packard HP-97 programmable calculator and to standard data communications devices.

36175 (PNL-SA—8383) **INSPECT: a package of computer programs for planning and evaluating safeguards inspections.** Mullen, M.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 12p. (CONF-800655—32). NTIS, PC A02/MF A01.

From 21. annual meeting of the Institute of Nuclear Materials Management; Palm Beach, FL, USA (30 Jun 1980).

As part of the US Program of Technical Assistance to IAEA Safeguards, PNL has developed a package of computer programs, called INSPECT, that can be used in planning and evaluating safeguards inspections of various types of nuclear facilities. The programs are based on the statistical methods described in Part F of the IAEA Safeguards Technical Manual and can be used to calculate the variance components of the MUF (Material Unaccounted For) statistic, the variance components of the D (difference) statistic, attribute and variables sampling plans, and a measure of the effectiveness of the inspection plan. The paper describes the programs, reviews a number of applications, and indicates areas for future work.

36176 Inventory verification using high-resolution gamma spectroscopy (HRG). Bartels, W.C. (Department of Energy, Washington, DC (USA)). pp 221-227 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Substantial improvement has been accomplished in high-resolution gamma spectroscopy (HRG) since 1970. This paper reviews the present status of inventory verification in the field of international safeguards. IAEA Consultant and Advisory Groups have considered the usefulness of many non-destructive assay techniques and recommended HRG for certain applications. These include the plutonium content and isotopic composition (except ^{242}Pu) of small samples; and plutonium isotopic composition of larger containers of bulk plutonium. HRG should be used for uranium enrichment measurement where there is a possibility of radiation interference from extraneous gammas. Another recommended use is in the verification of spent fuel. Improvements have been made in the capability at IAEA Headquarters for the analysis of HRG data from inspections. In addition, detection equipment and pulse-height analysers have been improved, and transportable equipment is being used for IAEA and Member State activities. The IAEA is increasing its capability for the calibration of HRG by the use of physical standards. The IAEA staff is receiving training in HRG applications to nuclear material accountability. There has been substantial progress and increasing use in HRG for nuclear material accounting and verification of inventories.

36177 Developmental aspects of a dynamic special nuclear materials control and accountability system. Bowers, G.L.; Darby, D.M.; Dunigan, T.H.; Sampson, T.E.; Cochran, J.L. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). pp 463-466 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

To improve the accountability of special nuclear materials (SNM) and provide a timely integrated item inventory of SNM in each material balance area (MBA), a Dynamic Special Nuclear Materials Control and Accountability System (DYMCAS) is proposed for the Oak Ridge Y-12 Plant. This paper describes three aspects of the DYMCAS effort in the Y-12 Plant. A broad overview of the system's features is followed by a discussion of the DYMCAS prototype work done in support of the final DYMCAS design and, finally, by a discussion of the non-destructive assay (NDA) effort in determining specific NDA requirements, operating procedures, standards development, and instrumentation precision.

36178 Procurement and use of reference materials for calibrating non-destructive assay equipment. Busca, G. (CEC Safeguards Directorate, Luxembourg); Cuypers, M.; Prosdocimi, A.; Stanchi, L. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Reilly, T.D. (Los Alamos Scientific Lab., NM (USA)). pp 315-325 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

The effort made jointly by the Euratom Safeguards Directorate, the Joint Research Centres of the CEC and the operators in the preparation, characterization and use of reference materials for non-destructive assay (NDA) is presented. General guidelines and some practical solutions for the procurement and use of reference materials (RM) or normalization samples (mostly in fuel fabrication and conversion plants) are reported. A consensus on the acceptance of some RMs widely used in the fuel cycle by national and international organizations is recognized as a necessary condition for improving the quality of the fissile materials assay on routine basis. The initial stages in this direction are mentioned. Furthermore, an optimization of the effort in the procurement of RM on the basis of a broad collaboration between Safeguards Authorities and operators is proposed as a solution to solve the problem of high-quality measurements in a continuously increasing fuel cycle where a large variety of materials is encountered.

36179 New neutron correlation measurement techniques for special nuclear material assay and accountability. Dowdy, E.J.; Henry, C.N.; Robba, A.A.; Pratt, J.C. (Los Alamos Scientific Lab., NM (USA)). pp 125-136 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Assay of plutonium samples using the moments of the neutron count distribution from a well counter has been demonstrated. Samples of various composition, and ranging in mass from a few tens of grams to several kilograms have been used in this demonstration. Several advantages over conventional coincidence counting methods have been realized. Among these are the ability to account for sample multiplication and the ability to detect and correct for detection system malfunction without the loss of even a single analysis cycle.

36180 Chapter 8. Safeguards technology. Paper 13. Safeguards techniques. Higinbotham, W.A. (Brookhaven National Lab., Upton, NY (USA)). pp 187-197 of Nuclear energy and nuclear weapon proliferation. London; Taylor and Francis (1979).

From Stockholm International Peace Research Institute symposium; Stockholm, Sweden (12 Oct 1978).

The technologies which would be needed for the IAEA to achieve its safeguards objectives at large nuclear fuel processing facilities are described in this paper, with special reference to a future, large nuclear fuel reprocessing plant. It will be necessary to employ an optimum combination of material accountancy, containment and surveillance. The design of such future safeguards systems would require that these future facilities be designed to facilitate IAEA safeguards. For each major section of a large future plant, the IAEA should: (a) observe and verify all measurements of nuclear materials transferred into and withdrawn from the area, (b) apply containment and surveillance to detect any undeclared additions and removals, and (c) employ instruments continually to monitor the materials in storage or in processing equipment. The necessary technologies exist but the member states, especially those which plan to build large new facilities, will have to assist the IAEA in their development and demonstration. It is noted that national safeguards programmes could profit from closer coordination with the national programmes for reactor safety and for radiation protection.

36181 Statistical analyses in nuclear accountability. A simulation approach. Johnson, M.E.; Tietjen, G.L.; Johnson, M.M. (Los Alamos Scientific Lab., NM (USA)). pp 371-376 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

This paper describes a computer simulation approach to modelling material balances and to deriving the limits of error attributable to measurement procedures. A new probability distribution is presented which is useful in the computer simulations. This distribution permits the investigator to assess the sensitivity of initial distributional assumptions on the computed limits of error. The simulation approach is illustrated with a case study example.

36182 Potential value of dynamic materials control in international safeguards. Keepin, G.R. (Los Alamos Scientific Lab., NM (USA)); Lovett, J.E. (International Atomic Energy Agency, Vienna (Austria)). pp 417-430 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

The difficulties inherent in conventional materials accountancy based on semi-annual or annual shutdown cleanout physical inventories have been recognized for many years. The increasing importance of international nuclear materials safeguards, coupled with the availability of advanced non-destructive measurement technology which could be installed on or near process lines, has led to the development of the concept of advanced or dynamic materials control. The potential benefits of dynamic materials control in terms of significantly improved detection capabilities (ranging from a few kilograms of plutonium down to perhaps a few hundred grams, even for large-scale bulk processing facilities), and even more dramatically improved detection timeliness (typically a few days, and potentially only a few hours, in advanced facilities), are reviewed. At least twelve major dynamic material control systems already in existence or in the process of being installed are noted, and some of the essential characteristics are discussed. Some currently unresolved questions are explored, and future prospects for the concept of dynamic material control in international safeguards are reviewed.

36183 Optimal estimates of inventory and losses using nuclear material accountancy data. Pike, D.H.; Morrison, G.W. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). pp 405-415 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

State-estimation theory has been shown to be applicable in obtaining minimum variance unbiased estimates of inventory and loss of special nuclear materials. The loss estimates are far superior to those obtained by the ID/LEID approach and the CUSUM approach. The technique may be extended to other situations where more complex models are appropriate. For example, one can add additional state variables to the system model to represent holdup at various points in the MBA. One could also model several interactive unit processes. So long as the system can be described by a linear system model, it is possible to construct a Kalman Filter and Linear Smoother to obtain minimum variance unbiased estimates of the state variables.

36184 Recent experience with a mobile safeguards non-destructive assay system. Sorenson, R.J.; Fager, J.E.; Brauer, F.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). pp 193-205 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

A mobile, real-time, non-destructive assay system for nuclear material safeguards applications has been designed, assembled, and evaluated. The system is designed to be used by either an independent agency for verification of prior measurements or by plant personnel for various sample measurements. The system consists of electronic and computer-support equipment mounted in a specially constructed vehicle. This vehicle also carries passive and active neutron and gamma-ray measurement equipment that is operated outside the vehicle. Currently, the analysis capabilities include gross sample weight, neutron counting, spontaneous fission neutron counting, gamma-ray spectrometry and fissile material detection by fissions induced with a neutron source. The minicomputer mounted in the vehicle is used for measurement control, data acquisition, and data analysis. Recent field experience with the system includes handling and measuring plutonium metal, plutonium oxide, and plutonium nitrate. A variety of fuel research materials has also been measured, including ^{233}U, ^{233}U, plutonium, and thorium in various matrices. The system has also been used to measure amounts of material received, stored, or shipped. Field measurements are now under way on a variety of fuel-cycle waste materials, such as low-enriched ^{235}U, high-enriched ^{235}U, and plutonium in heterogeneous matrices. During field use, a number of practical problems were encountered that are as important as the technical considerations in achieving results with the system. The question of calibration standards and attempts to operate without such standards are also discussed.

36185 Chapter 7. Hybrid reactors. Paper 11. Laser fusion and fusion hybrid breeders: proliferation implications. Westervelt, D. (Los Alamos Scientific Lab., NM (USA)); Pollock, R. pp 161-172 of Nuclear energy and nuclear weapon proliferation. London; Taylor and Francis (1979).

From Stockholm International Peace Research Institute symposium; Stockholm, Sweden (12 Oct 1978).

The laser fusion option, and particularly the fusion-fission hybrid breeder, carry with them strong technical implications for proliferation. Proof of the scientific feasibility of both magnetically confined fusion (MCF) and inertially confined fusion (ICF) may be close at hand, although technical and commercial feasibility are some distance away for both. Earlier entry into commercial feasibility may result if fusion sources are used to breed fissile Pu-239 or U-233, taking advantage of the resulting tenfold energy gain of fission over fusion. The result could be a practically inexhaustible energy source in, for example, reserves of fissionable (but largely non-fissile) uranium. The status of MCF and ICF research is briefly reviewed in order to demonstrate the scale of effort in these areas and to identify the major participants. Attention is then focused specifically on the fusion-fission hybrid breeder. The hybrid breeder offers the possibility of breeding reactor fuel efficiently in only a few carefully guarded nuclear parks and potentially in proliferation-resistant forms. The MCF breeder has little implication for the development of nuclear weapon technology, and institutional arrangements for control of the fissile material produced can be similar to those in other areas. It is suggested that economic factors will be primary determinants in the choice between thorium and uranium raw materials, the latter appearing more likely at present. The ICF breeder, in contrast to the MCF breeder, carries dual implications for proliferation: the supply of fissile materials, and the spread of knowledge useful for development of a thermonuclear weapon capability. ICF hybrids uniquely threaten to supply both 'limiting ingredients' essential for fusion weaponry - knowledge and fissile material.

36186 Development of a new survey assay meter to meet IAEA and United States Department of Energy requirements. Zucker, M.S.; Chase, R.L.; Stephani, D.; Fiarman, S.; Alberi, J.L. (Brookhaven National Lab., Upton, NY (USA)). pp 179-191 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

An instrument has been developed to supplant the Eberline Stabilized Assay Meter (ESAM) which has played an important role in safeguards, but has certain deficiencies and faults which gradually became apparent during its widespread usage. The result of this experience was that knowledgeable users felt an improved version of this instrument was needed which incorporated more recent electronic technology. An effort was made by the IAEA and the US Department of Energy to implement this. The result is the BNL Survey Assay Meter (BSAM) developed by Brookhaven National Laboratory's Technical Support Organization, and Instrumentation Division. The BSAM was designed after detailed analyses of the ESAM circuitry, operating experience with the ESAM by BNL, LASL, the IAEA, and other groups, and a review of the features considered desirable in a future instrument. Thus, the BSAM incorporates such operational features of the ESAM with improvements, together with several new features, which materially decrease the effort required to make measurements and reduce data to meaningful quantities.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 36089, 36099

FUSION FUELS

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

36187 (UCRL—84477) **Interferometric measurements of multilayer and double shell inertial fusion targets.** Weinstein, B.W.; Weir, J.T.; Willenborg, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Aug 1980. Contract W-7405-ENG-48. 22p. (CONF-801037—11). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Optical interference microscopy plays an important role in the measurement of targets for inertial confinement fusion experiments. We describe how these techniques are applied to the measurement of thickness and refractive index of multilayer films on both flat substrates and microsphere targets. We also discuss procedures for manipulating and examining microsphere targets to measure defects and wall thickness variations anywhere on the target. Finally, we describe the use of optical interferometry to measure the individual components and final assembled structure of double-shell targets. The accuracy of these measurements is from 0.03 to 0.5 μm, depending on the specific application.

36188 (UCRL—84488) **Use of molecular beams to support microspheres during plasma coating.** Crane, J.K.; Smith, R.D.; Johnson, W.L.; Letts, S.A.; Korbel, G.R.; Krenick, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Aug 1980. Contract W-7405-ENG-48. 23p. (CONF-801037—9). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Spherical laser fusion targets can be levitated on beams of Ar or other gas atoms. This is an especially useful and reliable technique for supporting microspheres during plasma coating or plasma etching. The reliability of this technique is principally the result of two things: the success of a special centering device which provides a lateral, stabilizing force on the levitated microspheres; and a gas handling system which is capable of controlling levitation gas flow in the microtorr liter/sec range. We have determined that the operational regime of this device is that of Knudsen's flow. This knowledge of the flow characteristics has been important in developing this device.

36189 (UCRL—844475) **Ultrasmooth plasma polymerized coatings for laser fusion targets.** Letts, S.A.; Myers, D.W.; Witt, L.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Aug 1980. Contract W-7405-ENG-48. 21p. (CONF-801037—12). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Coatings for laser fusion were deposited up to 135μm thick by plasma polymerization onto 140 μm diameter DT filled glass microspheres. Ultrasmooth surfaces (no defect higher than 0.1 μm) were achieved by eliminating particulate contamination. Process generated particles were eliminated by determining the optimum operating conditions of power (20 watts), gas flow (0.3 sccm trans-2-butene, 10.0 sccm hydrogen), and pressure (75 millitorr), and maintaining these conditions through feedback control. From a study of coating defects grown over known surface irregularities, a quantitative relationship between irregularity size, film thickness, and defect size was determined. This relationship was used to set standards for the maximum microshell surface irregularity tolerable in the production of hydrocarbon or fluorocarbon coated laser fusion targets.

36190 **Measurement of DT neutron-induced activity in glass-microshell laser fusion targets.** Lane, S.M.; Campbell, E.M.; Bennett, C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Appl. Phys. Lett.;* **37**: No. 7, 600-601(1 Oct 1980).

Laser fusion targets consisting of DT gas contained in Teflon-coated glass microshells produce 14.1-MeV neutrons that can interact with the ^{28}Si nuclei in the glass to produce radioactive ^{28}Al. Using a very efficient collection-detection scheme that could detect the decay of 10% of the ^{28}Al created, we identified these nuclei by their 1.78-MeV γ ray, which decayed with a 2.2-min half-life. From the number of ^{28}Al nuclei created and the neutron yield the compressed glass areal density was found to be 0.0059 g/cm^2.

REGULATIONS AND POLICY

REFER ALSO TO CITATION(S) 36185

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

RADIATION SOURCES

DESIGN AND FABRICATION

36191 **Ionizing radiation generator.** Akimov, J.; Ovcharov, A.; Panasjuk, V.; Romanovsky, V.; Stepanov, B. US Patent 4,210,813. 1 Jul 1980. Priority date 9 Jan 1978, Union of Soviet Socialist Republics (USSR), vpp.

a description is given of an ionizing radiation generator comprising: an ionizing radiation emitter including a resonance transformer and an accelerating tube; a field winding and a step-up winding, having a low-voltage and high-voltage ends, of said resonance transforemr, said field winding of said resonance transformer being arranged near said low-voltage end of said step-up winding; an electrically conducting housing of said resonance transformer, electrically associated with said low-voltage end of said step-up winding; a high-frequency oscillator electrically associated with said field winding; a high-voltage electrode of said accelerating tube, connected to said high-voltage end of said step-up winding of said resonance transformer; a tubular insulator of said accelerating tube, secured in said electrically conducting housing of said resonance transformer, said high-voltage electrode being attached to one end thereof; an inner space of said tubular insulator, accommodating said step-up winding of said resonance transformer; an evacuated inner space of said accelerating tube, confined between said electrically conducting housing of said resonance transformer and said tubular insulator; a low-voltage electrode of said accelerating tube, arranged in said electrically conducting housing of said resonance transformer and electrically associated with said housing; a source of charge particles of said accelerating tube, arranged in said evacuated space and electrically associated with one of said electrodes; a coolant supplied into said inner space of said tubular insulator, to said step-up winding of said resonance transformer and to said high-voltage electrode of said accelerting tube.

USE IN MEDICAL SUPPLY STERILIZATION

36192 (INIS-mf—5673) **Summaries of reports of 1. All-union scientific-technical conference on medical production radiation sterilization. Summaries of reports.** (Ministerstvo Zdravookhraneniya SSSR, Moscow). 1978. 94p. (In Russian). (CONF-7810242—(Summ.)). NTIS (US Sales Only), PC A05/MF A01.

From 1. all-union scientific--technical conference on medical production radiation sterilization; Moscow, USSR (24 Oct 1978).

Individual papers in scope were abstracted.

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 37222

ISOTOPIC POWER SUPPLIES

36193 (PNL—1845-47) **Quarterly report on the strontium heat source development program, Advanced Nuclear Systems and Projects Division for April-June 1980.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 10p. NTIS, PC A02/MF A01.

Oak Ridge National Laboratory completed metallographic examination of the metal specimens from the 30,000-h compatibility tests with $^{90}SrF_2$. Electron microprobe analysis of the specimens is now under way. Results show that chemical attack of the 30,000-h specimens was not much greater than that observed in the 6000- to 20,000-h tests. Work continues on qualification testing of the as-fabricated prototype outer capsules. As-fabricated Hastelloy S and Hastelloy C-4 outer capsules passed the hydrostatic pressure, percussion, thermal, and thermal-quench tests without difficulty.

HYDROGEN

REFER ALSO TO CITATION(S) 36778

PRODUCTION

36194 (NP—25005, pp 20p, Paper 15) **Thermochemical energy-hydrogen and its storage.** Mital, C.K. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Hydrogen production by electrolysis and thermochemical processes is discussed. The reactions for nine thermochemical cycles are given. Efficiencies of these cycles are compared. Hydrogen storage (compressed gas, underground storage, cryogenic storage, and metal hydrides) is briefly discussed.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 36197

36195 (NP—25005, pp 17p, Paper 16) **Thermochemical water decomposition to hydrogen using Westinghouse sulphur cycle.** Shankar, H.S. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Physical chemistry of electrochemical water splitting, process parameters; process alternatives, and economics of the Westinghouse Sulfur Cycle are discussed.

36196 **Liquid-permeable electrode.** Folser, G.R. (to Dept. of Energy). US Patent 4,193,860. 18 Mar 1980. Filed date 30 Aug 1978. 6p.

PAT-APPL-938,141.

Electrodes for use in an electrolytic cell, which are liquid-permeable and have low electrical resistance and high internal surface area are provided of a rigid, porous, carbonaceous matrix having activated carbon uniformly embedded throughout. The acti-

vated carbon may be catalyzed with platinum for improved electron transfer between electrode and electrolyte. Activated carbon is mixed with a powdered thermosc.iing phenolic resin and compacted to the desired shape in a heated mold to melt the resin and form the green electrode. The compact is then heated to a pyrolyzing temperature to carbonize and volatilize the resin, forming a rigid, porous structure. The permeable structure and high internal surface area are useful in electrolytic cells where it is necessary to continuously remove the products of the electrochemical reaction.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 36195

36197 (SLL—73-0061) **Hybrid processes for extraction of hydrogen from water.** Zehr, S.W.; Brierly, J.M.; Baskes, M.I. (Sandia Labs., Livermore, CA (USA)). Sep 1973. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01.

The need is clear to find an economical, clean-burning substitute for fossil fuels to reduce pollution and conserve fossil hydrocarbon resources. An attractive candidate for meeting this need is hydrogen produced from only water and energy. Conventional direct electrolysis for this purpose suffers from the low efficiency of the heat-to-electricity conversion step. Thus there is a need to develop more efficient and lower-cost alternative production processes. Cyclic multistep thermochemical processes are being considered by others for this purpose; however, the most attractive of these candidates use expensive intermediate substances which, even though recycled in the process, lead to very large inventory and capital requirements. Because of the large scale of projected energy requirements, additional effort is warranted to find processes involving cheaper intermediate substances and lower capital costs if hydrogen as a fuel is to have a significant beneficial impact.

36198 **Thermochemical production of hydrogen from water.** Bamberger, C.E.; Braunstein, J.; Richardson, D.M. (Oak Ridge National Lab., TN). *J. Chem. Educ.;* **55**: No. 9, 561-564(Sep 1978).

The importance of hydrogen in the developing energy economy, and the variety of methods for its generation, suggest it as a useful topic for study in the chemistry curriculum. Electrolysis of water is already widely dealt with, and the application of thermodynamic principles in the search for alternative methods should be instructive. The thermochemical cycle discussed may not prove to be the most economical, but it illustrates some of the principles with reactions which can be verified in the laboratory.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

36199 **Homogeneous catalysis of the photoreduction of water by visible light. Mediation by a tris(2,2'-bipyridine)ruthenium(II)-cobalt(II) macrocycle system.** Brown, G.M.; Brunschwig, B.S.; Creutz, C.; Endicott, J.F.; Sutin, N. (Brookhaven National Lab., Upton, NY). *J. Am. Chem. Soc.;* **101**: No. 5, 1298-1300(1979).

The quantum yields for hydrogen evolution in solutions containing $Ru(bpy)_3^{2+}$, $Co(II)(Me_6[14]dieneN_4)\text{-}(H_2O)_2^{2+}$, and the reducing agent were determined at 450 +- 20nm. These quantum yields are tabulated as a function of the concentration of the various reactants. With europium II as the reducing agent, the quantum yield for hydrogen evolution is independent of the cencentration of H_3O^+ in the range of 0.1 to 1.0 M. The probable steps leading to the hydrogen formation are outlined. The net light-driven reaction is $2\,Eu(II) + 2H^+ \rightarrow 2Eu(III) + H_2$. Experiments using broad-band irradiation were carried out to demonstrate that the evolution of hydrogen in this system is catalytic in $Ru(bpy)_3^{2+}$. 1 figure, 1 table.

STORAGE

REFER ALSO TO CITATION(S) 36194

CHEMISORPTION

REFER ALSO TO CITATION(S) 36899

OTHER SYNTHETIC AND NATURAL FUELS

PROPERTIES

REFER ALSO TO CITATION(S) 37014, 37038

PREPARATION

CHEMICAL SYNTHESIS

36200 **Synthetic carbonaceous fuels and feedstocks.** Steinberg, M. (to Dept. of Energy). US Patent 4,197,421. 8 Apr 1980. Filed date 17 Aug 1978. 8p.

PAT-APPL-934,765.

This invention relates to the use of a three compartment electolytic cell in the production of synthetic carbonaceous fuels and chemical feedstocks such as gasoline, methane and methanol by electrolyzing an aqueous sodium carbonate/bicarbonate solution, obtained from scrubbing atmospheric carbon dioxide with an aqueous sodium hydroxide solution, whereby the hydrogen generated at the cathode and the carbon dioxide liberated in the center compartment are combined thermocatalytically into methanol and gasoline blends. The oxygen generated at the anode is preferably vented into the atmosphere, and the regenerated sodium hydroxide produced at the cathode is reused for scrubbing the CO_2 from the atmosphere.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 35873, 36314, 36321, 36325, 36328, 36331, 36777, 36859

36201 (BNL—28297) **Flash hydrogenation of biomass.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-800973—2). NTIS, PC A02/MF A01.

From 11. biomass thermochemical conversion contractors meeting; Richland, WA, USA (23 Sep 1980).

It is proposed to obtain process chemistry information on the rapid hydrogenation of biomass (wood and other agricultural products) to produce light liquid and gaseous hydrocarbon fuels and feedstocks. The process is referred to as Flash Hydropyrolysis. The information will be of use in the design and evaluation of processes for the conversion of biomass to synthetic fuels and petrochemical feedstocks. Results obtained in an initial experiment are discussed.

36202 (DOE/PE—03871-01, pp 10.1-10.14) **Biomass gasification and liquefaction.** Nov 1979.

In Distributed energy systems: a review of related technologies.

A discussion on the pyrolysis of biomass to produce liquids or gases is presented. The conversion of biomass crops and residues is briefly discussed. Four processes for the conversion of municipal solid wastes to fuel gas are described in some detail. These are: Monsanto Landgard System; Torrox System; Union Carbide Purox System; and the Occidental Flash Pyrolysis System. These systems may be modified for the conversion of biomass. Gasifier products may be converted to methane or methanol by shift conversion, methanation, or catalytic conversion. The economics of the processes are discussed. (DMC)

36203 **Overall economics of anaerobic digestion.** Hashimoto, A.G.; Chen, Y.R.; Hruska, R.L. Clay City, NE; Department of Agriculture (1979). 24p. (CONF-7909173—1).

From International symposium on anaerobic digestion; Cardiff, Wales, UK (17 Sep 1979).

The anaerobic digestion process is technically feasible, can produce enough energy to satisfy the energy requirements of the digestion system and the rest of the beef enterprise, and is economically feasible in certain instances. Anaerobic digestion technology is at a stage where field demonstrations are appropriate to evaluate the problems associated with implementing the process. Functional designs which are compatible with the input substrate must be evaluated along with the labor and technical skills required to operate these processes. Institutional incentives such as risk sharing with governmental agencies, and tax, energy production and pollution control incentives are instruments which could be used to encourage the implementation of this process. Institutional barriers such as current regulations affecting the interface between utilities and farm producers of energy and the possible resistance by utilities to purchase the excess energy produced by the process must be addressed. Concurrent with these efforts must be a strong research program to optimize the digestion process. The factors which stimulate and inhibit methanogenesis, the factors which increase the availability of substrate to microbial attack, ways to increase the nutritional quality of the fermentor effluent, and evaluating the engineering design parameters necessary for optimum digester designs are suggested areas of further research. There are currently significant amounts of research in the anaerobic digestion of agricultural residue and several locations where full-scale fermentation systems are being built.

ALCOHOL FUELS

36204 USDA loan-guarantee program for industrial hydrocarbons and alcohols pilot projects. Barton, W.V.; Brown, H.E.; Fink, D.A.; Krochta, J.M. (USDA, Washington, DC). pp A10-A16 of Changing energy-use futures. Vol. 4. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The 1977 Food and Agricultural Act directed the Secretary of Agriculture to provide for four pilot projects for the production of industrial hydrocarbons and alcohols from agricultural commodities and forest products by guaranteeing loans, not to exceed $15,000,000 for each project. The intent was to stabilize and expand the market for such commodities and products and expand the domestic supply of hydrocarbons and alcohols. Evaluation criteria included the requirements that total energy content of products and byproducts from each project exceed the total energy input from fossil fuels and that each project be designed to demonstrate economic feasibility.

PROPERTIES

REFER ALSO TO CITATION(S) 35939

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 36200

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 36202, 36316, 36319, 36321

PREPARATION

REFER ALSO TO CITATION(S) 35868

SOLID WASTE AND WOOD FUELS

REFER ALSO TO CITATION(S) 36314, 36320, 36827

36205 (DOE/PE—03871-01, pp 8.1 to 8.12) **Solid fuels derived from biomass.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The recovery of materials from municipal solid wastes is discussed. A refuse recovery process called the Eco-Fuel-II process is described. This process produces a dry powder of high bulk density called Eco-Fuel-II. The economics of the system are analyzed. Limitations on the implementation of the technology are discussed. (DMC)

HYDRO ENERGY

36206 (CONF-801102—16) **DOE Small Hydropower Program.** Hickman, W.W.; McLaughlin, T.B. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 8p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

The scope of work and activities of the Department of Energy's National Small Hydropower Program are discussed. Each portion of the program is discussed to provide an overall view of the program's depth. The three major subprograms are the Demonstration Projects subprogram, the Engineering Development subprogram, and the Loan subprogram. Program results are presented by graphic illustrations where applicable.

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 36764

PLANT DESIGN AND OPERATION

36207 (DOE/PE—03871-01, pp 5.1-5.19) **Run-of-the-river hydroelectric power generation.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The design and operation of water turbines for run-of-the-river hydroelectric power generation, the economics of hydropower generation, possibilities for hydro development and redevelopment, and the environmental and safety aspects of hydro power are discussed. (LCL)

REGULATIONS AND LICENSING

36208 (DOE/RA/04934—07) **Legal obstacles and incentives to the third development of small-scale hydroelectric potential in the six New England states: executive summary.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract AS02-78RA04934. 75p. NTIS, PC A04/MF A01.

This executive summary describes the relationship of Federal law and regulation to state law and regulation of small-scale hydroelectric facilities. It also highlights important features of the constitutional law, statutory law, case law, and regulations of each of the six New England states. The summary may serve as a concise overview of and introduction to the detailed reports prepared by the Energy Law Institute on the legal and regulatory systems of each of the six states. The dual regulatory system is a function of the federalist nature of our government. This dual system is examined from the standpoint of the appropriate legal doctrine, i.e., the law of preemption, and the application of this law to the case of hydroelectric development. The regulation of small dams are discussed and flow diagrams of the regulations are presented for each of the six states - Maine, Massachusetts, Vermont, New Hampshire, Vermont, and Connecticut.

36209 (DOE/RA/04934—41) **Federal legal obstacles and incentives to the development of the small-scale hydroelectric potential of the nineteen Northeastern states. Executive summary.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract AS02-78RA04934. 58p. NTIS, PC A04/MF A01.

The main report for which this report is the executive summary, DOE/RA—23-216.00.0-01 (see EAPA 5:3929), was published in revised form in March 1979. Also, since that time, Energy Law Institute has produced detailed legal memoranda on obstacles and incentives for each of the 19 states. This executive summary summarizes the findings and observations of the original report. Specific summaries included are: Federal Jurisdiction Over Small-Scale Hydroelectric Facilities; The FERC; The Regulation of Construction in and the Discharge of Dredged, Fill, and Other Materials into the Waters of the US; The Protection of Fish, Wildlife, and Endangered Species; The Preservation of Historic Places, Archaeological Sites, and Natural Areas; Regulation of the Use of Federal Lands; Federal Dam Construction and Power-Distribution Agencies; Additional Federal Agencies Concerned with Small-Scale Hydroelectric Dams; Federal Tax Devices and Business Structures Affecting Small-Scale Hydroelectric Development; and an Outline of Federal-Assistance programs Available for Small-Scale Hydroelectric Development.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 36704

SOLAR ENERGY

REFER ALSO TO CITATION(S) 36778, 36779, 36865

36210 (ANL—80-80) **Argonne Solar Energy Program annual report. Summary of solar program activities for fiscal year 1979.** (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 83p. NTIS, PC A05/MF A01.

The R and D work done at Argonne National Laboratory on solar energy technologies during the period October 1, 1978 to September 30, 1979 is described. Technical areas included in the ANL solar program are solar energy collection, heating and cooling, thermal energy storage, ocean thermal energy conversion, photovoltaics, biomass conversion, satellite power systems, and solar liquid-metal MHD power systems.

36211 (TAC-STPG—80-002) **Solar thermal power generation: a bibliography with abstracts. Quarterly update, April-June 1980.** Sparkman, T.; Bozman, W.R. (eds.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1980. 214p. Univ. of New Mexico, Technology Application Center, Albuquerque.

This annotated bibliography covers the following subjects: energy overviews; solar overviews; energy conservation; environment, law, and policy; total energy systems; solar thermal power and energy storage; thermoelectric, thermionic, and thermolysis; Ocean Thermal Energy Conversion; wind energy; biomass; bioconversion, and photochemical; satellite power systems; and photovoltaic applications. (MHR)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 36450, 36583, 36584, 36585, 36586, 36587, 36588, 36589, 36590, 36591, 36592, 36593, 36594, 36595, 36596, 36597

36212 (ISWS/CIR—133/78) **Solar energy information and data for Illinois.** Changnon, S.A. Jr. (Illinois State Water Survey, Urbana (USA)). 1978. 61p. TIC.

A solar data compendium for Illinois is presented. The tabular data and charts came from three sources: the Environmental Data and Information Service (EDIS, formerly EDS) of NOAA, the Argonne National Laboratory at Lemont, Illinois, and the Illinois State Water Survey. Most of this information relates to: (1) radiation (largely solar, but some net); (2) sunshine (actual and percent possible); (3) cloud cover (percent and amount); (4) pollution (as it affects radiation); (5) temperature and humidity; (6) winds; and (7) weather conditions that would detrimentally affect solar units (hail, snowfall, ice, etc.). Unfortunately, there have been only two radiation stations operated in Illinois (at Lemont in the north for 15 years, and at Urbana in central Illinois for 17 years). Radiation results from both are presented, including daily values (Changnon, 1959). Many of the available detailed analyses of the radiation data at Lemont are presented, including radiation relationships with wind, temperatures, and humidity (Moses and Bogner, 1967). Available radiation data from Indianapolis, Indiana, and Columbia, Missouri (Baker and Klink, 1975) are presented to furnish estimates of conditions in south-central and southern Illinois, respectively. The first-order weather stations operated since about 1900 by the National Weather Service at Chicago, Indianapolis, Moline, Peoria, Springfield, St. Louis, Evansville, and Cairo have recorded sunshine and cloud (sky) cover data. Average monthly values of temperatures (and extremes of temperature), relative humidity, and winds are offered for various state locales. Various weather conditions that will create problems for solar collectors are reviewed. Included are average and extreme values of hail, thunderstorms, pollution, snow, and ice. (WHK)

36213 (NP—25005, pp 30p, Paper 3) **Solar radiation.** Sukhatme, S.P. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The availability of solar radiation as an energy resource is discussed. A discussion of extra-terrestrial radiation, its spectral distribution and the radiation at the earth's surface is given. Instruments used for measuring solar radiation and methods used for presenting data are then described. The geometry of solar radiation and the various angles used are defined so that it is possible to convert the flux on one plane to an equivalent flux on another. Equations for predicting the availability of solar radiation at a location are given.

36214 (SOLAR/0010—80/08) **Environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Aug 1980. Contract AC01-79CS30027. 257p. NTIS, PC A12/MF A01.

The Detartment of Energy's National Solar Data Program established solar energy systems in residential and commercial buildings across the United States. These solar sites are linked to Vitro Laboratories Division's computer in the National Solar Data Network (NSDN). Vitro collects and analyzes data from this network to determine the thermal performance of each of the solar systems. Environmental information collected at the sites for the month of August 1980 is presented. The environmental data for the NSDN are presented in the form of tables for each solar site. The solar sites are grouped into 12 zones, each of which consists of several adjacent states. The solar energy sites are in alphabetical sequence within each zone. The tables provide available meteorological data for reporting sites in the NSDN as follows: (1) Insolation: the insolation table presents the total, diffuse, direct, maximum, and extra-terrestrial radiation for the solar site. It also shows the ratio of total extra-terrestrial radiation, as a percent; (2) Temperature: the temperature table gives the average, daytime, nighttime, maximum, minimum, and Inlet-water temperatures for the solar site. Additional tables are presented for some of these NSDN sites, supplying either wind or relative humidity data, or both. All of the passive and some of the active solar sites are equipped with wind sensors. These provide information for two wind tables. The first furnishes wind speed and direction. The second table correlates wind speed with time (hours for a range of speeds) for each day. The humidity table provides relative humidity values for day and night. It also gives values for the maximum and minimum humidity for each day. A technical discussion of the instruments and measurements used to obtain these data tables is given. (WHK)

ECONOMICS

REFER ALSO TO CITATION(S) 36234, 36283, 36399, 36444, 36445, 36476, 36720, 36741, 36742, 36748, 36776

36215 (CONF-790890—) **Final proceedings of the solar export issues workshop.** (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center; New Mark Consulting Group, Inc., Bethesda, MD (USA)). Oct 1979. Contract EG-77-S-05-5362. 255p. NTIS, PC A12/MF A01.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Twenty four papers and the Domestic Policy Review of Solar Energy were abstracted. Also included in the proceedings are lists of issues and recommendations. (MHR)

36216 (CONF-790890—, pp C.39-C.42) **A general strategy for RD & D cooperation with industrial nations.** Herwig, L.O. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The strategy is described including the following subjects: search and evaluation of overseas ideas, review of overseas activities, integration of overseas information, cooperation in selected overseas projects, adaptive RD and D for overseas needs, and use of overseas specialized capabilities. (MHR)

36217 (CONF-790890—, pp C.43-C.48) **The impact of international funding sources on US solar export opportunities.** Teagan, W.P. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Several issues in funding solar projects are discussed: funding availability, funding dispersement, fundability requirements, and near-term strategy. (MHR)

36218 (CONF-790890—, pp C.49-C.57) **Impact of multilateral trade negotiations on US solar export measures.** West, T.G. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Six of the commercial codes included in the Multilateral Trade Negotiations agreement are listed and three are discussed in some detail. These three are: subsides/countervailing measures, government procurement, and technical barriers to trade. (MHR)

36219 (CONF-790890—, pp C.67-C.72) **International considerations in project financing August 1979.** Stingel, D.E. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The activities of the Export - Import Bank in aiding US companies in getting contracts and financing in various countries are reviewed. (MHR)

36220 (CONF-790890—, pp C.73-C.74) **International scales: Panacea or Pandora's Box.** Pardo, B. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Some recommendations are made based on previous experience in foreign trade. (MHR)

36221 (CONF-790890—, pp C.75-C.76) **International trade in solar-energy equipment.** Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

36222 (CONF-790890—, pp C.77-C.92) **Metrication of US solar-energy systems for export markets.** Christensen, D.L. (Univ. of Alabama, Huntsville). Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The advantages of metrification for the export market are presented. Included in an appendix are the proposed international recommendations for solar radiation terminology, units, and symbols. (MHR)

36223 (CONF-790890—, pp C.109-C.110) **Product intercomparison in the international market.** Losey, R. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

36224 (CONF-790890—, pp C.111-C.114) **Solar energy, Department of Energy new key initiatives.** Thomas, J. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The programs which can assist the solar-energy industry in its efforts to market overseas are described briefly. Some of these are: a computerized information systems, global market surveys, marketing tools, seminars, and the Export Mailing List Service. (MHR)

36225 (CONF-790890—, pp C.115-C.117) **Solar international trade promotion.** Butt, S.H. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

It is proposed that the decision-makers in foreign trade be identified and that the potential advantages of the US solar industry be identified for promotion. Some specific suggestions of methods for promoting US solar products are listed. (MHR)

36226 (CONF-790890—, pp C.119-C.121) **Solaron experience with international marketing.** Loef, G.O.G. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

36227 (CONF-790890—, pp C.123-C.124) **Solar orientation and training for US foreign officers and selected local employees.** Sills, C.F. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The topics which should be included in a course for those who might have to explain the capabilities of American solar-energy system manufacturers are listed. (MHR)

36228 (CONF-790890—, pp C.125-C.132) **Some ideas for a model US solar export effort.** Doyle, D.W. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Some of the problem areas surrounding US exports are addressed, including the assets that can be marshalled by foreign countries and firms to form a strong competition or resistance to US exports. Some of the actions that could be taken to improve the situation and a model export effort that could be employed are cataloged. (MHR)

36229 (CONF-790890—, pp C.133-C.137) **Summary of the photovoltaic international plan meeting July 9, 1979.** Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

A set of proposed methods of government intervention are listed, which the DOE could use to stimulate the potential market for photovoltaics in the developing countries. (MHR)

36230 (CONF-790890—, pp C.151-C.156) **Update of the international solar market: 1985-2000.** Cantor, D.J. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

Reasons for thinking that the report of the International Panel of Solar Energy Domestic Policy Review on the international solar market is unduly pessimistic are presented. Figures are presented to support this contention. (MHR)

36231 (CONF-800491—, pp 594-597) **Economic potential of SPS.** Johnson, O.E. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The costs of Solar Power Satellites are estimated, and capital investment and lifetime costs are tabulated for SPS, coal, and nuclear power plants for comparison. Also, the cost per kWh for SPS and coal power plants are graphed. (WHK)

36232 (CONF-800491—, pp 610-611) **Macroeconomic/socioeconomic comparisons of SPS and alternative energy technologies.** Ayres, R.U. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 36429, 36430, 36431, 36432, 36441, 37243, 37244, 37245, 37246, 37247, 37249, 37273, 37274, 37275, 37276

36233 (CONF-790890—, pp B.7-B.43) **Domestic policy review (DPR) of solar energy.** Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

A group of options is proposed to: increase solar awareness and understanding in the US and abroad and encourage US industry participation in developing the international solar market. The options are listed and an assessment of the potential impact in the near term or long term is included. Also included are cost estimates to the United States Government. (MHR)

36234 (CONF-790890—, pp C.157) **Utilization of solar technologies by socialist governments.** Morgan, K. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

36235 (CONF-800491—, pp 37-53) **Environmental assessment overview.** Valentino, A.R. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The key environmental issues associated with the satellite power system concern human health and safety, ecosystems, climate, and interaction with electromagnetic systems. Five tasks have been established to address these issues: (1) microwave health and ecological effects; (2) nonmicrowave health and ecological effects; (3) atmospheric effects; (4) effects on communication systems due to ionospheric disturbance; and (5) electromagnetic compatibility. These tasks are briefly described. (WHK)

36236 (CONF-800491—, pp 54-65) **Societal assessment overview.** Bloomquist, C.E. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The decision to proceed with SPS will depend on a political determination that commitment of the economic, institutional, and social energies required for its implementation is a worthwhile investment. This determination will be national (and international) in scope and will be based on knowledge of the environmental and societal impacts of the SPS, its projected economics and technological risks, expressed through the influence of contending segments of society. To assist the decision makers, an assessment of societal issues associated with the SPS has been undertaken as part of the Concept Development and Evaluation Program. Results of the assessement are reported. The primary societal assessment objectives are: (1) to determine if the societal ramifications of an SPS might significantly impede its development, and (2) to establish an information base regarding these issues. The approach taken to meet these objectives is oriented to serve the needs of the decision makers. That is, the studies conducted are not intended to be exhaustive treatments of the issues addressed; rather, they are to provide estimates regarding SPS impacts commensurate with its stage of development and the needs of the decision makers. The four major areas of the societal assessment are: resources, institutional issues, international implications, and public concerns.

36237 (CONF-800491—, pp 113-115) **Overview of atmospheric effects.** Rote, D.M. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Effluents from the transportation system are the major cause of SPS-related atmospheric effects. These effects include inadvertent weather modification, air quality degradation, compositional changes in the stratosphere and mesosphere, formation of noctilucent clouds, plasma density changes, airglow enhancements, and changes in composition and dynamics of the plasmasphere and magnetosphere. In most cases, these effects have been difficult to assess because they involve processes that are either not well-understood by the scientific community or are speculative in nature, or because they involve extrapolations of known effects to unprecedented scales. Hence, with few exceptions, the results should be regarded as tentative. Some of these atmospheric effects are briefly discussed.

36238 (CONF-800491—, pp 116-119) **Ionospheric disturbance overview.** Rush, C.M. (Inst. for Telecommunication Sciences, Boulder, CO). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The operation of the Satellite Power System (SPS) is currently designed to provide between 5 to 10 gigiwatts of power on a continuing basis to the surface of the earth. At the center of the microwave power beam, the power density is of the same magnitude that could lead to enhanced heating of the ionosphere and to the creation of changes in the structure of the ionosphere. The degree to which the ionosphere and ionospheric-dependent telecommunication systems will be impacted by the operation of the SPS is, therefore, of concern; and a research program is briefly described.

36239 (CONF-800491—, pp 120-121) **Electromagnetic compatibility overview.** Davis, K.C. (Pacific Northwest Lab., Richland, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

In the process of delivering 5 Gw of electrical power the SPS will, due to limitations of available technology, contribute undesired electromagnetic radiation over a broad spatial and spectral range. Because of the large power handled by SPS and the extreme sensitivity of some other electromagnetic systems, even a very small fractional loss from the SPS can have a major impact. A brief review on the assessment of the Electromagnetic Compatibility (EMC) impact of SPS is given. (WHK)

36240 (CONF-800491—, pp 122-123) **Nonmicrowave health and ecological effects: overview.** White, M.R. (Univ. of California, Berkeley). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The study being carried out under the auspices of the Department of Energy to assess the environmental impacts of the Satellite Power System (SPS) is reviewed. The assessment is using as a baseline the 1978 SPS Reference System developed by NASA and its contractors. The potential impacts are based on current knowledge with regard to the consequences of constructing and operating SPS as defined by the reference system. Studies of the non-microwave health and the ecological effects encompass impacts on the public, the terrestrial worker, the space worker, and ecology and agriculture.

36241 (CONF-800491—, pp 124) **SPS microwave health and ecological effects: program area overview.** Cahill, D.F. (Environmental Protection Agency, Triangle Park, NC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36242 (CONF-800491—, pp 129-132) **Societal assessment: institutional issues.** Shotland, S.I. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The objectives of institutional issues studies during the CDEP were to (1) define key institutional areas, (2) establish an information base, and (3) determine whether institutional mechanisms might significantly affect SPS development. Four basic areas were addressed. These included: finance and management scenarios; regulatory issues; SPS utility integration; and SPS insurance. These studies are briefly described. (WHK)

36243 (CONF-800491—, pp 133-134) **Societal assessment: international issues.** Daurio, A. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Studies were undertaken in essentially two phases. Preliminary assessment studies dealt with international agreements (primarily associated with availability of geostationary orbit positions, allocation of the radiofrequency spectrum and microwave exposure standards) and military implications of the SPS. Other papers concerned with prospective organizational structures and finance and management contributed to a preliminary understanding of international issues. Studies are briefly described.

36244 (CONF-800491—, pp 135-137) **Public concerns.** McNeal, S.R. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The role of the public in the SPS Concept Development and Evaluation Program (CDEP) is briefly discussed. The role of the public is important for two reasons: (1) public acceptance is an essential part of its ultimate realization; (2) public acceptance is no longer possible unless the public is involved, to the extent that its concerns are made known and satisfactorily resolved in the development process.

36245 (CONF-800491—, pp 150-153) **Comparative health and safety assessment of the SPS and alternative electrical generation systems.** Habegger, L.J.; Gasper, J.R.; Brown, C.D. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A comparative analysis of health and safety risks is presented for the satellite power system (SPS) and five alternative baseload electrical generation systems: a low-Btu coal gasification system with an open-cycle gas turbine combined with a steam topping cycle (CG/CC); a light water fission reactor system without fuel reprocessng (LWR); a liquid metal fast breeder fission reactor system (LMFBR); a central station terrestrial photovoltaic system (CTPV); and a first generation fusion system with magnetic confinement. For comparison, risk from a decentralized roof-top photovoltaic system with battery storage (DTPV) is also evaluated. Quantified estimates of public and occupational risks within ranges of uncertainty were developed for each phase of the energy system on the basis of 1000 MWe average system output. A load factor of 70% was assumed for each system except the CTPV and DTPV for which 25% and 12% load factors, respectively, were used. Back-up energy systems were not included in the evaluation. Components of the analytical procedure are illustrated. Also discussed is the potential significance of related major health and safety issues that remain unquantified.

36246 (CONF-800491—, pp 154-157) **Environmental welfare comparison.** Whitfield, R.G. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Environmental welfare effects are defined as those effects from environmental degradation due to electrical power generation which are not directly related to public or occupational health and safety but concern the well-being of individuals. Studies were conducted to investigate pathways of energy activities which may cause environmental impacts and lead to welfare effects. Six activities contributing to the the fuel cycle for eight energy technologies were defined, characterized, and studied in terms of resultant environmental impacts; welfare effects were classified into six categories. Study results include identification of priority welfare effects based on severity of occurrence and state of knowledge about uncertainty. Results are summarized.

36247 (CONF-800491—, pp 158-161) **Resources/macroeconomic/institutional comparative assessment.** Whitfield, R.G. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Three areas important in the Comparative Assessment of energy technologies are resource requirements, macroeconomic effects, and institutional considerations. Scenarios (alternative energy futures) developed as part of the SPS Concept Development and Evaluation Program were used to provide another perspective on the land and water resources required; macroeconomic results followed from the scenario development activity. The institutional analysis, completed before development of the scenarios, focussed on regulatory issues. Results are briefly discussed.

36248 (CONF-800491—, pp 396-399) **Preliminary planning for future SPS microwave health and ecology research and assessment.** Hamilton, C.W. (Battelle Columbus Labs., Columbus, OH). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The objective of the SPS microwave health and ecology assessment task is to identify, characterize and estimate the magnitude of potential bioeffects attributable to microwave radiation (MWR) at SPS reference system power densities and frequencies. This assessment includes effects on airborne biota, terrestrial and space workers, the general public and the ecology. The general toxicological categories that are being investigated include immunology and hematology, mutagenesis, carcinogenesis, reproduction, development and growth, behavior, physiologic and integrative processes, and drug interactions and special populations. The preliminary research and assessment program plan is outlined. (WHK)

36249 (CONF-800491—, pp 400-402) **Simulated D- and E-region effects of the SPS power beam.** Showen, R.L. (SRI International, Menlo Park, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Since the beginnings of commercial broadcasting, the lower ionosphere has been inadvertently heated. The classical Luxembourg effect, in which the audio modulation from a powerful radio transmitter is weakly transferred to another radiowave passing overhead, is due to electron heating. The mechanism of the Luxembourg effect is reviewed, the transmitters used to simulate the solar power satellite (SPS) microwave power beam are identified, and results of various experiments are discussed.

36250 (CONF-800491—, pp 403-406) **Microwave heating of the lower ionosphere.** Meltz, G.; Nighan, W.L. (United Technologies Research Center, East Hartford, CT). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The SPS microwave power beam is sufficiently intense to cause large changes in the properties of the lower ionosphere by ohmic heating of the plasma. The development of a predictive model of the underdense interaction of an electromagnetic beam and the lower ionosphere is addressed. The interaction is considered to be underdense if the electromagnetic frequency exceeds the maximum plasma frequency throughout the ionospheric region of interest. A self-consistent fluid theory formulation of underdense heating, incorporating the latest information on electron cooling and electron-temperature-dependent reaction rates, has been used to estimate the expected changes in the lower ionosphere due to the SPS beam. A computer code has been developed to integrate the coupled equations for power density, electron temperature, and electron density as a function of altitude and time for both time-varying and steady heating fluxes. (WHK)

36251 (CONF-800491—, pp 407) **Ionosphere/microwave beam interactions: Arecibo experimental results.** Duncan, L.M. (Los Alamos National Scientific Lab., NM); Gordon, W.E. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36252 (CONF-800491—, pp 408-409) **SPS heating in the lower ionsphere, an experimental view.** Djuth, F.T.; Coco, D.S.; Fleisch, D.A.; Ganguly, S. (Rice Univ., Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

It is predicted that heating by the SPS microwave beam will substantially increase ambient electron temperatures and modify

electron density distributions within the ionosphere. In the present study, the incoherent scatter radar at Arecibo Observatory is used to investigate enhanced electron heating in the D and E regions of the ionosphere and irregularity formation at E-region altitudes. Results are briefly discussed.

36253 (CONF-800491—, pp 410-413) **Laboratory and proposed ionospheric experiments on SPS microwave instability.** Le-Cong, P. (Power Conversion Technology, Inc., San Diego, CA); Phelps, D.; Drummond, J.; Lovberg, R.; Thompson, W. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Thermal self-focusing theory predicts that the overall effect of the interaction between the ionospheric plasma and the satellite power beam would be amplification of naturally occuring electron density striations. The theory has been extended to include laboratory conditions: a 6 ms pulsed, 0 to 3 kW, 2.45 GHz beam focused with a 0.5m x 0.6m horn and variable lens onto a 0.7m diameter window of a 1m x 2.5m Helium-Argon plasma produced by a 0.5m x 2m cross-section, 100 kV, ~ 100A electron beam. Provision is made to spatially modulate the e-beam to produce density striations about currently measured densities of up to ~ 2×10^9 e/cm^3. Even without this pre-modulation, preliminary measurements indicate a dependence of phase on microwave power that is a key phenomenon predicted by thermal instability theory. The measurements were made at power levels below the point where the microwave ionization affected the Langmuir probe measured plasma density. The experimental approach and important results are described.

36254 (CONF-800491—, pp 440-443) **Rectenna-related atmospheric effects.** Lee, J. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The effects of an SPS rectenna on local weather and climate are discussed. Analyses and model simulations in some chosen site situations and meteorological conditions indicate that the meteorological effects of the construction and operation of a rectenna are small, particularly outside the boundary of the structure. From weather and climate points of view, installation of an SPS rectenna seems likely to have effects comparable with those due to other nonindustrial land-use changes covering the same area. The absorption and scattering of microwave radiation in the troposphere would have negligible atmospheric effects. (WHK)

36255 (CONF-800491—, pp 444-445) **Ground cloud air quality effects.** Brubaker, K.L. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The effects on air quality of the launching of a large rocket such as the HLLV are discussed. The ground cloud represents a source of air pollution and associated effects. It is stated that the only substances which are potentially significant from an air quality point of view are the nitrogen oxides. The enhanced ground-level concentration of NO_2 and the enhancement of acid rain in the vicinity of the launch site due to NO_2 are briefly discussed. (WHK)

36256 (CONF-800491—, pp 446-449) **Ground-cloud-related weather modification effects.** Lee, J. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The proposed heavy lift launch vehicle (HLLV) would emit a large amount of thermal energy to the atmospheric boundary layer. The buoyancy resulting from this thermal energy release will raise the exhaust ground cloud to an altitude from several hundred to several thousand meters, depending upon the ambient meteorological conditions. Meanwhile, the upward convective motion of the ground cloud and the surrounding air may result in the formation of a water-saturated cloud and associated precipitation. In addition, cloud microphysical processes may be affected by the production in the rocket exhaust of both cloud condensation nuclei (CCN) and ice-forming nuclei (IN). The principal concerns about inadvertent weather modification by SPS rocket effluents are (1) the possibility that the ground cloud might temporarily modify local weather and (2) the cumulative effects of nearly 500 launches per year. These issues of concern are discussed through the consideration of (1) the possible alteration of the microphysical processes of clouds in the general area due to rocket effluents and debris and cooling water entrained during the launch and (2) the direct dynamical and thermodynamical responses to the inputs of thermal energy and moisture from the rocket exhaust for given ambient meteorological conditions.

36257 (CONF-800491—, pp 450-451) **Overview of HLLV effluents in stratosphere and above.** Brubaker, K.L. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The single most important SPS-related cause of large-scale upper atmospheric effects is the injection of large quantities of rocket exhaust effluent into atmospheric regions in which the exhaust products are naturally present only in trace quantities. Of the four vehicles involved, the heavy lift launch vehicle (HLLV) is by far the most important source of exhaust effluent in the region between the Earth's surface and low-Earth orbit (LEO). This discussion provides an overview of HLLV emissions and the corresponding potential atmospheric effects.

36258 (CONF-800491—, pp 452-453) **Mesospheric cloud formations.** Forbes, J.M. (Boston College, Chestnut Hill, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The natural existence of noctilucent clouds at high latitudes during summer suggests that deposition of large amounts of H_2O by HLLV exhausts near the cold mesopause (85 Km) could result in the formation of mesospheric clouds. Studies of mesospheric cloud formation indicate that three conditions must be met in order to form and maintain clouds near the mesopause: (1) homogeneous nucleation is slow, and condensation nuclei are required for sufficiently fast growth of ice particles; (2) the ambient temperature must be less than the frost point temperature at which saturation occurs; and (3) sufficiently large vertical velocities might be required to ensure growth of ice to required dimensions (~ .1μ) for a given water vapor contents. These conditions are discussed. Also, from the point of view of assessing SPS-related effects, the frequency and magnitude of H_2O injections are factors to be considered.

36259 (CONF-800491—, pp 454-457) **D- and E-region effects.** Forbes, J.M. (Boston College, Chestnut Hill, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A time-dependent analytic formalism is utilized to examine the competing effects of transport, photodissociation, and frequency of injection on the steady-state global distribution of HLLV second-stage discharges of H_2O, and to estimate concomitant effects on the ion chemistries of the D- and E-regions.

36260 (CONF-800491—, pp 458-459) **Environmental effects of SPS: the middle atmosphere.** Whitten, R.C. (Ames Research Center, Moffett Field, CA); Borucki, W.J.; Park, C.; Woodward, H.T.; Turco, R.P.; Prasad, S.S.; Capone, L.A.; Riegel, C.A. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The heavy lift launch vehicles associated with the SPS would deposit in the upper atmosphere exhaust and reentry products which could modify the composition of the stratosphere, mesosphere, and lower ionosphere. In order to assess such effects, model simulations have been performed to assess the modifications, especially in a geographic zone centered at the launch and reentry latitudes. The models used are briefly discussed.

36261 (CONF-800491—, pp 460-463) **Sunlight reflections from a solar power satellite or solares mirrors should not harm the eyes.** Hyson, M.T. (California Inst. of Tech., Pasadena, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A Solar Power Satellite (SPS) located at geosynchronous orbit (GEO) could collect sunlight above the atmosphere and return 5 to 10 gigawatts of electrical energy to the earth using a microwave beam from an array of klystrons arranged as a transmitter one kilometer in diameter. The transmitter must point continuously at a receiver on the earth. During some phases of the SPS orbit, the transmitter would reflect an image of the sun to the ground. It has been suggested that the reflected beam could harm an observer's eyes. It is shown here that this problem is minimal. The reflection, while bright, would not be dangerous.

36262 (CONF-800491—, pp 464-468) **Characterization of reflected light from the space power system.** Liemohn, H.B.; Tingey, D.L.; Holze, D.H.; Sperber, B.R. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The development and operation of a Space Power System would place very large structures in orbit around earth for several decades. Sunlight reflected off such structures, particularly specular components from large flat areas, is expected to create ground illumination that will attract observers. In order to assure that this illumination does not exceed the irradiance tolerances of the eye, reflections from these satellites must be carefully controlled by vehicle orientation and surface specifications. The solar power satellite (SPS) at geosynchronous altitude (GEO) has 55 km^2 of glass covered solar cells that are oriented normal to the sun, as well as a 1 km^2 microwave antenna. Transportation of construction materials from low earth orbit (LEO) to GEO requires 23 Orbit Transfer Vehicles (OTVs) that have 1.6 km^2 solar panels oriented normal to the sun during their 6 month transits. The Staging Base (SB) at LEO,

that accommodated OTV fabrication and cargo transfer, consists of 0.5 km arms protruding from a .44 km^2 open grid aligned with its orbit plane. Diffuse reflections would make the SB/OTVs readily discernible in the daytime and the OTVS and SPSs observable all night (except during eclipse). Sporadic specular glints would appear on the ground from the OTVs and SPSs near the midnight meridian, from the solar panel surfaces of OTVs during LEO fabrication, and from OTVs near LEO at dawn and dusk. The ground level irradiance has been evaluated for several unusually bright configurations using the Baseline System Design. For example, the present microwave antenna on SPS produces ground irradiance comparable to that from the full moon during operations around the equinoxes. Various modifications in the design and operation are suggested to reduce the brightness of these reflections.

36263 (CONF-800491—, pp 469-472) **Prototype environmental assessment of the impacts of siting and construction of an SPS ground receiving station.** Hill, J. (Environmental Resources Group, Los Angeles, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A prototype assessment of the environmental impacts of siting and constructing a Satellite Power System (SPS) Ground Receiving Station (GRS) is given. The objectives of the study are: (1) to develop an assessment of the non-microwave-related impacts of the reference system SPS GRS on the natural environment (microwave health and safety and communications impacts were not assessed); (2) to assess the impacts of GRS construction and operations in the context of actual baseline data for a site in the California desert about 250 kilometers north of Los Angeles referred to as Rose Valley/Coso; and (3) to identify critical GRS characateristics or parameters that are most significant in terms of the natural environment.

36264 (CONF-800491—, pp 473-474) **Effects of the space environment on the health and safety of space workers.** Hull, W.E. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Large numbers of individuals are required to work in space to assemble and operate a Solar Power Satellite. Little is known about the physiological and behavioral consequences when large groups of men and women perform complex tasks in the vehicular or extravehicular environments over long periods of orbital stay time. The current data base is limited to United States and Soviet experiences involving only 2 to 3 persons at a time and for a maximum of 6 months. There are no specifically applicable data relating to inspace behavioral or social performance in populations of mixed gender. Data relating to physiological performance are generally encouraging. The most disturbing consequences of exposure to the null-gravity environment relate to (1) a generalized cardiovascular deconditioning along with loss of a significant amount of body fluid volume, (2) loss of bone minerals and muscle mass, and (3) degraded performance of neural mechanisms which govern equilibrium and spatial orientation. These topics are briefly discussed.

36265 (CONF-800491—, pp 475-476) **Hazards to space workers from ionizing radiation in the SPS environment.** Lyman, J.T. (Lawrence Berkeley Lab., CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Background information and a preliminary assessment of the potential risks to workers from the ionizing radiation encountered in space are given. The report (1) summarizes the current knowledge of the space radiation environment to which space workers will be exposed; (2) reviews the biological effects of ionizing radiation considered of major importance to a SPS project; and (3) discusses the health implications of exposure of populations of space workers to the radiations likely to penetrate through the shielding provided by the SPS work stations and habitat shelters of the SPS Reference System.

36266 (CONF-800491—, pp 477-479) **Late biological effects of heavy charged particles: cataracts, vascular injury and life shortening in mice.** Ainsworth, E.J.; Jose, J.G.; Barker, M.E.; Alpen, E.L. (Univ. of California, Berkeley). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Manned space flights are now a reality and may increase in the future in connection with use of advanced technologies, such as satellite power systems (SPS) to generate electricity. However, many of the risks associated with extended habitation in a space environment remain undetermined. Of particular concern at this time are the hazards to space workers that might result from exposure to high energy heavy ion particles (HZE). Less is known about the biological consequences of HZE than about other types of radiations encountered in space. Conventional types of shielding used for radiation protection do not shield out these particles. No data are available currently to assess lens damage and repair after low doses of HZE particles. Thus, more information is needed about biological effects of HZE in order to assess their potential adverse health hazards. Of considerable importance are the potential effects of HZE particles on the crystalline lens of the eye, because this tissue has proven susceptible to x- and gamma rays and particularly susceptible to the action of other forms of high LET radiation such as fission-spectrum neutrons. Because carcinogenic effects and blood vessel (vascular) damage are also of great importance for radiation risk assessment, several animal experiments are in progress to evaluate dose-response relationships for tumor-induction/promotion and for vascular injury. This presentation concentrates on cataract productions, yet preliminary results on carcinogenic and vascular effects are presented for perspective.

36267 (CONF-800491—, pp 480-482) **Ionospheric observations: archived data and the HEAO-C launch.** Mendillo, M.; Chacko, C.C. (Boston Univ. MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36268 (CONF-800491—, pp 506-507) **Military implications of satellite power systems.** Vajk, J.P. (Science Applications, Inc., Pleasanton, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Satellite Power Systems (such as the SPS Reference Design currently under study by DOE and NASA) entail enormous expansions in total mass, power, logistic capabilities, and personnel in space. These expanded capabilities, far greater than for any other space program envisaged during the next few decades, raise important questions about potential military uses of power satellites and related facilities, both on Earth and in space. Moreover, the emplacement of major economic assets vital to the economic security of a nation in outer space, beyond the territorial limits of any sovereign state, raises important questions about the vulnerability of such assets to overt military attack or to terrorist actions. Vulnerability, safeguards, and recommendations are discussed. (WHK)

36269 (CONF-800491—, pp 508-510) **Some aspects of SPS acceptability in Europe.** Shelton, R.M.; Franklin, I.V. (British Aerospace Dynamics Group, Bristol, UK). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

SPS has international implications because of its nature and its scale; we believe that these imply international involvement and participation. This in turn requires consideration of other nations' requirements and preferences. SPS Acceptability embraces in a sense the whole scope of the US Concept Development and Evaluation Programme. It is intended to select a few areas where European, and in particular UK, conditions may differ from those upon which the US SPS Reference System were based. Three aspects of SPS acceptability are discussed: Environmental, the Utilities interface, and Political and Public acceptability.

36270 (CONF-800491—, pp 511) **Strategies for marshalling international support for solar power systems.** Bailey, D.G.; Irwin, N.A. (IBI Group, Toronto, Ontario). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36271 (CONF-800491—, pp 512-513) **Alternative international political reactions to SPS.** Brownell, J.R. Jr.; Stoil, M.J. (KAPPA Systems, Inc., Arlington, VA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Several studies incorporated in the assessment of the Satellite Power System (SPS) concept and its societal implications refer to the issue of international reaction to SPS research and commercialization. The general findings of the earlier studies, summarized in the SPS Preliminary Societal Assessment (May 1979), suggest that an international organization is strongly suggested for SPS development and commercialization. An institution similar to COMSAT/INTELSAT is described as the optimum means of dealing with international reactions to SPS. The rationale for this finding are briefly discussed. (WHK)

36272 (CONF-800491—, pp 514-516) **Internationalization of the SPS: US policy issues, options and strategies.** Gorove, S. (Mississippi Univ., University). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Perhaps the most important key issue that US policy makers will have to face is whether the United States should internationalize the SPS and, if so, in what manner the United States should proceed. In order to arrive at a rational decision, a careful assessment must be made of the pros and cons of internationalization with reference to the totality of the basic value and institutional processes rather than on the basis of a single value or institutional alternative. Positive or negative answers may well depend on the meaning of the term internationalization and various possible forms which it may assume.

Policy options and possible international arrangements are discussed. (WHK)

36273 (CONF-800491—, pp 517-520) **Satellite power system rectenna siting study.** Blackburn, J.B. Jr.; Bavinger, B.A. (Rice Univ., Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The goal of this study was to determine if potential sites for receiving antennas existed within the Continental United States. A receiving antenna located at 35 degrees north latitude would require the dedication of approximately 35,000 acres to the elliptical rectenna and associated buffer zone (vertical dimension, 15.8 km; horizontal dimension, 12.0 km). The SPS reference design contemplates the development of 60 receiving antennas within the Continental United States over a 30 year time frame. Our approach to site availability was to eliminate areas as sites rather than attempting to locate sites. Three classifications of land use contraints were developed. These were (1) areas absolutely excluded, (2) areas potentially excluded, and (3) areas exhibiting characteristics that would exclude the reference-system rectenna but were available if design modifications were made. Data was gathered depicting the spatial coverage of variables within the three classifications. In all, 37 variables were mapped. Many variables were comprised of several gradients which were mapped separately. In all, 67 data items (excluding states and electrical reliability council regions) were mapped. Fifteen variables were classified as absolute exclusion variables, 21 were classified as potential variables and 30 were classified as design/cost variables. An overlay map of absolute exclusion variables is included.

36274 (CONF-800491—, pp 521-524) **Relationship of eligible areas to projected electrical demand.** Kotin, A.D. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Siting of 60 ground receiving stations (rectennas) for the SPS may pose a problem due to the large area per rectenna (15,000 hectares, 38,000 acres) and numerous siting constraints. This presentation extends the analysis of potentially eligible areas defined in an extensive computer mapping effort by Rice University in which conditions which would preclude rectenna construction were mapped on a 7.5 minute national grid in which each grid cell correponds roughly to a single rectenna site. The major topics considered are: (1) other factors which will tend to reduce the number of available sites; (2) the relationship of eligible areas to the need for SPS power, as reflectd in projected regional generation estimates; and (3) some preliminary ranking of US regions in terms of siting difficulty.

36275 (CONF-800491—, pp 525-528) **Prototype societal assessment of the impacts of siting and construction of an SPS ground receiving station.** Bachrach, A. (Environmental Resources Group, Los Angeles, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A prototype assessment of the societal impacts of siting and constructing a Satellite Power System (SPS) Ground Receiving Station (GRS) is described. The objectives of the study are: (1) to develop an assessment of the nonmicrowave-related impacts of the reference system SPS GRS on the human environment; (2) to assess the impacts of GRS construction and operations in the context of actual baseline data for a site in the California desert about 250 kilometers north of Los Angeles referred to as Rose Valley/Coso, and (3) to identify critical GRS characteristics or parameters that are most significant in terms of the human environment.

36276 (CONF-800491—, pp 534-535) **Social acceptability of satellite power systems: a preliminary exploration.** Klineberg, S.L. (Rice Univ., Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36277 (CONF-800491—, pp 540-541) **Concerns of the citizens' energy project about the SPS.** Bossong, K. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

During 1979, the Citizens' Energy Project prepared summaries of 22 of the SPS white papers issued by the US Department of Energy. The summaries were mailed to approximately 3000 individuals and organizations including environmental & consumer groups, solar businesses & citizen groups, local government and public utility commission representatives, labor unions, alternative press contacts, and individuals interested in the SPS issue. In response to the request for comments on these summaries, 381 letters and other written comments were received as well as almost two dozen verbal comments. These comments are discussed.

36278 (CONF-800491—, pp 542-543) **Concerns of the L-5 society about SPS.** Henson, C.; Harlan, A.; Bennett, J.C. (L-5 Society, Tucson, AZ). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The L-5 Society is a pro-space citizens' group. It promotes space development in governmental, private and industrial sectors. Over the period of January 1979 through April 1980 it conducted a public outreach program on the Satellite Power System (SPS) for Planning Research Corporation (PRC). As part of this outreach, the L-5 Society sent copies of PRC's and the Department of Energy's 1978 reports on various aspects of the SPS project to a core group of spokespeople for the pro-space constituency both in the US and abroad. Telephone interviews were conducted with these people as well as obtaining a number of in-depth written reports. Responses are summarized.

36279 (CONF-800491—, pp 544-547) **Concerns of FASST about the SPS.** Ladwig, A.M. (Forum for the Advancement of Students in Science & Technology, Inc., Washington, DC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Forum participated in a public outreach experiment with two other organizations - the Citizens' Energy Project and the L-5 Society. The selected outreach method consisted of sending 3000 students and faculty members an SPS Briefing Packet. The Packet included student-written summaries (in the FASST BRIEFING format) of 19 studies on the SPS reference system the societal assessment review, and the environmental, health and safety review. Also included in the Packet were a cover letter explaining the Public Review Program, a Response Form, and a postage-paid envelope for the Form. The Response Forms were then analyzed and categorized by the Forum. Responses are summarized.

36280 (CONF-800491—, pp 548-551) **Societal assessment of student participation in the evaluation of the satellite power system concept.** Wood, R.D. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A satellite power system technology assessment was performed by a group of 15 senior aeronautics students at Central Washington University. The group was composed of two females, two Air Force ROTC students, one Marine Corps student, one Puerto Rican student, a student from Saudi Arabia, with the remaining students being from the Pacific Northwest or California. Responses are summarized.

36281 (CONF-800491—, pp 558-561) **Satellite power systems (SPS): the need for a detailed assessment to develop feasible management schemes.** Kaplan, M.S. (General Accounting Office, Washington, DC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36282 (CONF-800491—, pp 562-563) **Some judicial and regulatory factors.** Entres, S.L. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Recently, General Technology Systems Ltd. carried out, on behalf of the UK Department of Industry, a study of the future industrialization of space. The major effort was devoted to Space Power Systems (SPS). This particular part of the study was based largely on a search and critical evaluation of published information, mainly of US origin and available up to the end of 1978. Results are briefly discussed. Political, legal, regulator, and institutional issues are outlined. (WHK)

36283 (CONF-800491—, pp 568-569) **Economic and environmental impacts of solar satellite power systems (SSPS).** Passerini, E. (Univ. of Alabama, University). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36284 (CONF-800491—, pp 570-571) **Sources and nature of resistance to satellite power system (SPS) development.** McDaniel, W.E. (Niagara Univ., NY). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36285 (CONF-800491—, pp 572-573) **Sun bust, or why SPS will never get off the ground.** Pate, D.S. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36286 (CONF-800491—, pp 581-582) **Institutional considerations of SPS/utility integration.** Crist, M.S. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

This study investigates institutional development of the US utility industry and how various scenarios of industry evolution would affect utility involvement in the SPS program. The implications of past and ongoing structural changes in oil prices and energy economics, alternate energy technology developments, national

energy policy, state regulatory climates, and financial pressures are analyzed for their impacts on utility perceptions of SPS viability.

36287 (CONF-800491—, pp 607-609) **Resource comparisons (land, water, and materials).** Wilson, W.B. (Teknekron Research, Inc., McLean, VA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

This paper compares and evaluates the land, water, and material requirements of eight energy systems: coal w/FGD, coal gasification c/c, light water reactors, liquid metal fast breeder reactors, centralized and decentralized photovoltaic solar power systems, and satellite power systems (SPS). The assessment involves both a side-by-side comparison of the eight energy systems, normalized to 1250 MWe of capacity, and an alternative future analysis in which the resource requirements of the technologies are evaluated across time. Graphs are included.

36288 (CONF-800491—, pp 612) **Environmental welfare effects evaluation.** Wilson, W.B. (Teknekron Research, Inc., McLean, VA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36289 (CONF-800491—, pp 613) **Climate and energy: a comparative assessment of SPS and alternative energy technologies.** Kellermeyer, D. (HDR Ecosciences, Santa Barbara, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36290 (DOE/ET/20537—1) **Numerical study of local/regional atmospheric changes caused by a large solar central receiver power plant. Final report, 29 September 1978-31 May 1980.** Bhumralkar, C.M.; Slemmons, A.J.; Nitz, K.C. (SRI International, Menlo Park, CA (USA)). May 1980. Contract AT03-76ET20537. 72p. NTIS, PC A04/MF A01.

A two-dimensional, vertical cross-section, numerical atmospheric mesoscale model has been applied to study the potential local/regional atmospheric effects of the installation of a 100 MW/ sub e/ solar thermal central receiver power plant at Barstow, California. The model can simulate the changes in surface characteristics associated with the installation of heliostats and other power plant ancilliaries, and can simulate the effects of waste heat from cooling towers. The model equations have been integrated to simulate typical summer, atypical summer, and typical winter conditions. The results for typical summer conditions at Barstow and the surrounding region show that the power plant has the potential to increase local humidity and wind circulation but cannot induce the formation of clouds or rain. The results for atypical summer conditions show that the solar power plant has the potential to increase the wind circulation and to form clouds and rain. However, the life cycle of such formations is only 2 to 3 hours. The results for typical winter conditions do not indicate significant atmospheric perturbations as a result of solar power plant installation. Sensitivity to the type and location of cooling tower has been tested and described. The atmospheric effects of a dry cooling tower located upwind are not as significant and intense as those produced using a wet cooling tower. The effect of a wet cooling tower located at the downwind edge of the power plant is an increase in humidity in the downwind portion of the model atmosphere. The effects of solar-power plant-induced atmospheric changes on the performance and design of the power plant itself have also been examined and are shown to be significantly affected in atypical conditions.

36291 (HUD-PDR—481(2)) **Site planning for solar access: a guidebook for residential developers and site planners.** Erley, D.; Jaffe, M. (American Planning Association, Chicago, IL; Living Systems, Winters, CA (USA)). May 1980. Contract AT01-76CS60225. 144p. NTIS, PC A07/MF A01.

The following topics are discussed: site selection and analysis, preliminary site planning, general design approaches and techniques for solar access, specific design strategies to protect solar access, trees and landscaping, two examples of solar site planning, and private agreements to protect solar access: covenants and easements. Included in appendices are: a glossary, skyspace angles, shadow length tables and equation, determining density, and references. (MHR)

36292 (SERI/TP—743-826) **Environmental aspects of solar energy technologies.** Strojan, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1980. Contract AC02-77CH00178. 21p. (CONF-800867—2). NTIS, PC A02/MF A01.

From Symposium on energy and ecology in the West; Tucson, AZ, USA (4 Aug 1980).

Solar energy technologies have environmental effects, and these may be positive or negative compared with current ways of producing energy. In this respect, solar energy technologies are no different from other energy systems. Where solar energy technologies differ is that no unresolvable technological problems (e.g., CO_2 emissions) or sociopolitical barriers (e.g., waste disposal, catastrophic accidents) have been identified. This report reviews some of the environmental aspects of solar energy technologies and ongoing research designed to identify and resolve potential environmental concerns. It is important to continue research and assessment of environmental aspects of solar energy to ensure that unanticipated problems do not arise. It is also important that the knowledge gained through such environmental research be incorporated into technology development programs and policy initiatives.

36293 **Solar/Conservation Task Force. Final report.** Salem, OR; Oregon Department of Energy (1980). 116p. (NP—25021).

The following subjects are covered: the economic physical potential of solar/conservation resource, the status of the solar/conservation resource, impact of solar/conservation, and impact of recommended programs. Major policy recommendations are presented for new and existing homes; new and existing commercial buildings; the industrial sector; energy information, consumer protection, and research, development, and demonstration; and financing. Included in appendices are: the Technical Support Document, economic and job impacts of solar and conservation, environmental analysis for conservation and solar measures. Conservation is treated as an energy source. (MHR)

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 36437

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 36415, 36501

36294 (AD-A—079635/9) **High efficiency solar panel, Phase II, gallium arsenide. Interim report 15 Sep 77-15 Jan 79.** Vendura, G.; Kamath, S.; Wolfe, G. (Hughes Aircraft Co., Los Angeles, CA (USA)). Jul 1979. Contract F33615-77-C-3150. 65p. NTIS, PC A04/MF A01.

This interim report presents the progress of the GaAs High Efficiency Solar Panel program (Phase II) goal of development of space qualified solar cells of 16 percent efficiency AMO during the period of September 1977 through January 1979. Results of development research involving the basic GaAs substrate, the epitaxial reactors, LPE growth processes, ohmic contacts/metallizations, welding capability, and environmental testing are included. Efforts to increase substrate size and fabrication yield to enhance the feasibility of larger scale GaAs solar cell production are also detailed.

36295 (AD-A—079712/6) **N-type molybdenum diselenide-based liquid junction solar cells: a non-aqueous electrolyte system employing the chlorine/chloride couple. Technical report.** Schneemeyer, L.F.; Wrighton, M.S.; Stacy, A.; Sienko, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 19 Dec 1979. Contract N00014-78-C-0630. 20p. NTIS, PC A02/MF A01.

Single crystal, n-type $MoSe_2$ is shown to serve as a stable photoanode in an electrochemical cell employing a nonaqueous (CH_3CN) solution of Cl_2/Cl/sup -/ as the redox active material. The photoanode reaction is 2Cl/sup -/ Cl_2 and the cathode reaction is Cl_2 2Cl/sup -/. The $MoSe_2$ is qualitatively beter than MoS_2 (0.5% efficiency) which has a larger band gap (1.7 eV), but both materials are rugged in the nonaqueous solution while both photocorrode in aqueous Cl(-) solutions. In H_2O, the I_3/sup -/I/sup -/ couple is excellent but in CH_3CN it yields lower efficiency than the Cl_2/Cl/sup -// couple. The stable Cl2(-)/Cl(-) system provides evidence that a transparent, reversible, non-0_2 sensitive redox couple can be useful in n-type semiconductor-based liquid junction cells employing a direct band gap material having optimum solar response.

36296 (CONF-800491—, pp 258-262) **Survey of the market, supply and availability of gallium.** Rosi, F.D. (Univ. of Virginia, Charlottesville). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The major market for gallium is the electronics industry, which requires the metal in its highest form of purity (99.9999%). The price for this grade of gallium is now $525/kg. The free-enterprise consumption of gallium is estimated to be 14,000 kg., and is not expected to increase significantly over the next few years despite the emergence of new electronic applications requiring gallium compounds, such as magnetic bubble memories and optical fiber telecommunications. Since the free world production capacity of gallium is about 25,000 kg., an over-supply situation now exists. This could be dramatically reversed with the widespread use of gallium arsenide photovoltaic cells in future terrestrial and space power systems. Tables are given for US consumption of gallium by end use and commercial bauxite production and reserves in 1978. (WHK)

36297 (COO—4094-89) **Analytical predictions of liquid and air photovoltaic/thermal flat-plate collector performance.** Raghuraman, P.; Hendrie, S.D. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract AC02-76ET20279. 8p. (CONF-801102—23). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Two separate one-dimensional analyses have been developed for the prediction of the thermal and electrical performance of both liquid and air flat-plate photovoltaic/thermal (PV/T) collectors. The analyses account for the temperature difference between the primary insolation absorber (the photovoltaic cells) and the secondary absorber (a thermal absorber flat plate). The results of the analyses are compared with test measurements, and therefrom, design recommendations are made to maximize the total energy extracted from the collectors.

36298 (DOE/CH/00178—T3) **Emerging materials for solar cell applications: electrodeposited CdTe. First quarter report, February 15-May 15, 1980.** Rod, R.L.; Basol, B.; Stafsudd, O. (Monosolar, Inc., Santa Monica, CA (USA)). 30 Jun 1980. Contract AC02-77CH00178. 17p. NTIS, PC A02/MF A01.

The present program is a continuation of earlier efforts to develop electrochemically deposited films of compound semiconductors and solar cells made from them. Primary objectives include the development and characterization of controllably doped n and p type CdTe films with densities of 5.8 gm/cm^3, appropriate grain sizes, good film morphology and freedom from pinholes, and carrier concentrations from 10^{16} to 10^{18}/cm^3. The end result of the effort is to demonstrate by the seventh month, or September 15, 1980, solar cells over 1 cm^2 in area showing total area conversion efficiencies exceeding 4%. By the end of the first quarter, milestones were met calling for us to supply characterized n type CdTe films that were reproducible and free from pinholes. Also, prototype electrodeposited CdTe solar cells were fabricated and evaluated. Characterizations of p-type CdTe and ZnTe films were complicated by interferences existing between them and adjacent substrates. A number of devices, including the glass/ITO/n-CdTe:In/Au Schottky structure and an ITO/n-CdTe:In/p-Cu/sub 2-x/Te heterojunction, have been fabricated. The highest internal efficiency of the Schottky devices, which have yet to have fingered grids and anti-reflection coatings applied, is 4%. The heterojunction is a larger area device 2 cm^2 in area. It shows promise of meeting the 4% total area efficiency as does the Schottky when grids and A/R coatings are applied.

36299 (DOE/ET/23008—T1) **Emerging materials for solar cell applications: electrodeposited CdTe. Final report, February 14, 1979-February 14, 1980.** Rod, R.L.; Bunshah, R.; Stafsudd, O.; Basol, B.M.; Nath, P. (Monosolar, Inc., Santa Monica, CA (USA)). 15 May 1980. Contract AC04-79ET23008. 80p. NTIS, PC A05/MF A01.

Thin film gold/polycrystalline cadmium telluride Schottky solar cells made by electrodepositing the semiconductor on an ITO-coated glass substrate serving also as an ohmic contact demonstrated an internal efficiency of 4% over 2 mm^2 areas. During the year being reported upon, Monosolar devoted mator attention to refining the electroplating process and determining the parameters governing CdTe film stoichiometry, grain size, substrate adhesion, and quality. UCLA acting as a Monosolar sub-contractor characterized both the CdTe films themselves and solar cells made from them. Techniques were developed for making measurements on films often less than 1 micron in thickness. The highest values achieved for efficiency parameters, not necessarily all in the same cell, were V/sub oc/ = 0.5 V, J/sub sc/ = 11 mA/cm^2, and fill factor = 0.55 before corrections in the absence of anti-reflection coatings. Typical resistivities for n-CdTe films were 10^5 Ω-cm. Lifetimes of about 10^{-10} sec were measured. Absorption coefficient of these films is in the order of 10^4 for $\lambda < 0.7$ μm. Measured energy gap for these CdTe films is 1.55 eV, sightly higher than the 1.45 eV value for single crystal CdTe. The activation energy of the dominating trap level is 0.55 eV. Trap density is in the order of 10^{16}/cm^3. Schottky diodes were of excellent quality and pinhole-free. The measured barrier height varied between 0.75 and 0.85 eV. Rectification ratios of 10^3 were obtained reproducibly. Films measure about 1 inch square. Indications are that larger and more efficient low cost solar devices can readily be obtained soon using the techniques developed in this program.

36300 (DOE/ET/23049—1) **Fundamental studies of M-S and MIS solar cells on polycrystalline silicon. Quarterly report, January 1, 1979-September 30, 1979.** Yang, E.S.; Card, H.C. (Columbia Univ., New York (USA). Dept. of Electrical Engineering). 31 Oct 1979. Contract AC03-79ET23049. 60p. NTIS, PC A04/MF A01.

A theoretical investigation of electronic transport in metal contacts to polycrystalline silicon thin films is presented. Calculations based upon the reported values of grain boundary potentials indicate that the thermionic emission theory may be applied to the majority carrier transport only for low bias voltages. At larger bias voltages, one needs to take account of the voltage lost to the space charge regions adjacent to the grain boundaries, and a transition from electrode-limited to bulk-limited majority carrier transport results. It is further demonstrated that the injection of minority carriers can dominate the dark current for a range of grain size and interface state densities at the grain boundaries. Schottky barrier diodes using aluminum on p-type polycrystalline silicon have been fabricated. The contrast of the orientation of neighboring grains is observed after chemical etching of the surface. Comparing the surface morphology of the substrate with the electronic behavior of the Schottky diode, we are able to identify the influence of grain boundaries. It is found that the low-angle boundary has little effect on the I-V characteristics since near ideal Schottky I-V curves are obtained. The experimental data indicate that recombination centers and traps are introduced resulting in an increase in recombination current and a reduction of the effective mobility. An experimental study of Au-polycrystalline GaAs Schottky barriers has also been made. The current-voltage and capacitance-voltage characteristics of GaAs films of various grain sizes have been measured. Results are presented. (WHK)

36301 (DOE/JPL—1012-44) **Progress Report 15, December 1979-April 1980, and proceedings of the fifteenth Project Integration Meeting.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1980. Contract AI01-76ET20356. 388p. (JPL-PUB—80-27; CONF-8004116—). NTIS, PC A17/MF A01.

From 15. low-cost solar array project intergration meeting; Pasadena, CA, USA (2 Apr 1980).

Progress made by the Low-Cost Solar Array Project during the period December 1979 to April 1980 is reported. Reports on project analysis and integration; technology development in silicon material, large-area silicon sheet and encapsulation; production process and equipment development; engineering; and operations are included. Also, a report on, and copies of visual presentations made at, the Project Integration Meeting held April 2 and 3, 1980, are included.

36302 (DOE/JPL/954343—80/20) **Process feasibility study in support of silicon material task 1. Quarterly technical progress report (XX), June 1-August 31, 1980.** Yaws, C.L.; Li, K.Y. (Lamar Univ., Beaumont, TX (USA). Dept. of Chemical Engineering). Sep 1980. Contract NAS-7-100-954343. 37p. NTIS, PC A03/MF A01.

Analyses of process system properties were continued for chemical materials important in the production of silicon including compilation and collection activities of the property data for use in the final report. Major efforts in chemical engineering analysis centered on the DCS process - Case A which involves production of dichlorosilane (DCS) as a silicon source material for polysilicon production in the Hemlock Semiconductor Corporation program. The preliminary process design of a plant to produce DCS was completed including process flowsheet (100%), base case conditions (100%), reaction chemistry (100%), raw materials (100%), utilities (100%), major process equipment (100%) and production labor (100%). The process design package was forwarded for economic analysis. Economic analysis of the DCS process - Case A was completed during this reporting period. The results for dichlorosilane (DCS) indicated a total product cost without profit of 1.29 $/kg (1980 dollars). This product cost without profit includes direct manufacturing cost, indirect manufacturing cost, plant overhead and general expenses. The sales price of DCS at 15% DCF rate of return on investment is 1.47$/kg (1980 dollars). Additional results are reported for sales price of dichlorosilane at various profitability levels as measured by ROI (return on original investment) and DCF (discounted cash flow rate of return).

36303 (DOE/JPL/955270—80/2) **Low cost Czochralski crystal growing technology: near term implementation of the flat plate photovoltaic cost reduction of the Low Cost Solar Array Project. Fifth quarterly progress report, April 1-June 30, 1980.** Roberts, E.G. (Kayex Corp., Rochester, NY (USA)). 1980. Contract NAS-7-100-955270. 31p. NTIS, PC A03/MF A01.

During this reporting period, the primary activity has been to develop microprocessor control of the crystal growth process and to develop and demonstrate the accelerated crystal growth program. Accelerated recharging of the quartz crucible by the RF melting of polycrystalline silicon feed rods was deemphasized by JPL primarily due to the unavailability of suitable quality feed rods at an effective economical price. The development of the cold crucible program as an alternative method of crucible recharging was continued, but at a lower priority. Work continued on the accelerated crystal growth program. Crystal growth runs were made utilizing the water cooled work coil previously used in the RF polycrystalline silicon rod melting program. Accelerated growth rates were demonstrated but an oxide build-up on the cold surface of the work coil, resulting in heavy flaking and consequent falling of oxide into the melt, resulted in abandoning this approach and redesigning, evaluating, and demonstrating an alternative heat sink arrangement. All necessary parts were received for the cold crucible premelter and system was assembled and interfaced to the multiturn high voltage RF power supply.

36304 (DOE/JPL/955567—80/2) **Design, analysis, and test verification of advanced encapsulation system. Triannual report for period ending 30 July 1980.** Garcia, A.; Minning, C.; Perrygo, C. (Spectrolab, Inc., Sylmar, CA (USA)). Aug 1980. Contract NAS-7-100-955567. 84p. NTIS, PC A05/MF A01.

An optical model has been developed which will predict the amount of incident sunlight reaching the cell surface as well as determining the heat absorbed in encapsulation layers above the cells in a given module design. These results can be factored into a thermal model which will predict the NOCT of a given design. An electrical analysis has been performed which will aid in the selection of properly sized (for thickness) layers in a given module design. Differing allowable voltages may be integrated into the model. Work has begun on the structural model using the MSC NASTRAN finite element model computer program. An algorithm has been developed for determining the total system life-cycle energy cost for ranking module systems.

36305 (ERC-R—80025) **Terrestrial photovoltaic power systems with sunlight concentration. Annual progress report, 1979.** Backus, C.E.; Wood, B.D. (Arizona State Univ., Tempe (USA). School of Engineering). Jun 1980. Contract AC04-76DP00789. 155p. NTIS, PC A08/MF A01.

Cell testing procedures at ASU have been improved to increase the confidence in the test results as well as the development of techniques to improve cell mounting. A combined theoretical and experimental investigation was made of the effects of nonuniformity of illumination on the electrical performance of solar cells. Various illumination profiles were experimentally imposed on the cell and electrical performance evaluated. In general it has been shown the effect of nonuniform illumination on the efficiency of the solar cell depends on the type of profile and location relative to busbar and grid fingers. A separate theoretical and experimental investigation was made of the effects of nonuniform temperature profiles in concentrator cells. These variations of temperature can occur under high concentrations if there are imperfections in the bond between the concentrator cell and its cooled substrate. A computer model was developed to predict solar cell performance under nonuniform temperature operation and experiments were performed on commercially available concentrator solar cells to validate model predictions. The magnitude of temperature nonuniformities caused by voids in the solar cell solder bond increases as the cell thickness decreases and intensity increases. Computer algorithms were developed to evaluate the performance characteristics of combined photovoltaic-thermal (PV-T) solar collectors. This work emphasizes flat plate PV-T collectors but attention was also given to a detailed model for concentrating collectors. As expected, the extended fin geometries induce a greater degree of air turbulence and thus improves the fluid thermal conductance for a given mass flow rate. In general, the more turbulence generated by the duct, the greater the thermal output for a given flow rate. Results are presented in detail. (WHK)

36306 (LMSC-D—766341) **Cadmium sulfide/copper sulfide heterojunction cell research. Final report, February 26, 1979-May 31, 1980.** Anderson, W.W.; Jonath, A.D. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). Jun 1980. Contract AC02-77CH00178. 68p. NTIS, PC A04/MF A01.

Several all-sputter-deposited Cu_2S/CdS cells have been prepared to date with J/sub SC/ $\sim$ = 3 mA/cm^2 under simulated AM 1 illumination. The best AM 1 conversion efficiency obtained is 0.6%. This is typical of sputtered CdS in Cu_2S/CdS cells investigated to date. The sputtered Cu_2S appears to be satisfactory for solar cell applications. Present evidence indicates that the poor conversion efficiency is due to a low-junction electric field intensity on the CdS side of the heterojunction. A multilayedr CdS structure has been developed which may allow the tailoring of the junction electric field intensity to a selected high value to obtain high-junction collection efficiency. Hybrid process cells consisting of sputter-deposited CdS with conventional dry processed Cu_2S were also prepared. The best of these cells exhibited a short-circuit current density of 6.9 mA/cm^2 and a conversion efficiency of 1.18%.

36307 (NP—25005, pp 20p, Paper 4) **Photovoltaic solar cell.** Sharon, M. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The theory of operation, criteria for maximum efficiency, power output, and the various types of photovoltaic cells are discussed. (WHK)

36308 (SERI/PR—0-8254-3) **Amorphous thin films for solar-cell applications. Quarterly report No. 3, 11 March-10 June 1980.** Carlson, D.E.; Crandall, R.S.; Dresner, J.; Goldstein, B.; Hanak, J.J.; Pankove, J.I.; Schade, H.E.; Staebler, D.L.; Weakliem, H.A.; Williams, R. (RCA Labs., Princeton, NJ (USA)). Jun 1980. Contract AC02-77CH00178. 76p. NTIS, PC A05/MF A01.

A research program on hydrogenated amorphous silicon (a-Si:H) and the a-Si:H solar cell is described that includes six research tasks: theoretical modeling, deposition and doping studies, experimental methods for the characterization of a-Si:H, formation of solar-cell structures, theoretical and experimental evaluation of solar-cell parameters, and an investigation of stacked junction cells. Progress is reported in detail. (WHK)

36309 (SERI/PR—8031-1-T1) **Photoelectronic properties of zinc phosphide crystals, films and heterojunctions. Quarterly progress report No. 5, April 1-June 30, 1980.** Bube, R.H. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1980. Contract AC02-77CH00178. 12p. NTIS, PC A02/MF A01.

Growth of Zn_3P_2 crystals using a chemical transport method with iodine as the transport agent produced a successful growth run with greatly enhanced growth rate. Surprisingly, the electrical properties of the crystal appear to be unaffected by the iodine transport agent. This method is being explored as an alternative to thermal diffusion for doping of Zn_3P_2. Hall effect measurements have been made on several Zn_3P_2 crystals as a function of temperature. Measured hole mobilities were between 10 and 20 cm^2/V-sec. The mobility varies with temperature in the expected way for lattice scattering at higher temperatures and charged imperfection scattering at lower temperatures. n-CdO/p-Zn_3P_2 junctions were prepared by rf sputtering of CdO on Zn_3P_2 crystal substrates, both with and without previous etching of the surface. Poor dark diode and almost absent light response were measured. Thin films of Zn_3P_2 grown by close-spaced vapor transport have a higher growth rate in H_2 than in Ar. Thermoelectric power measurements are being prepared to analyze the transport properties in these films.

36310 (SERI/PR—8081-1-T1) **Materials for high efficiency monolothic multigap concentrator solar cells. Quarterly report No. 4, January 1-March 31, 1980.** (Varian Associates, Inc., Palo Alto, CA (USA)). 1980. Contract AC02-77CH00178. 25p. NTIS, PC A02/MF A01.

The objectives of this work are to develop a materials technology of the AlGaInAs and AlInAsSb mixed crystal systems. These technologies are directed towards the development of a two-gap, monolithic, lattice-matched concentrator cell with 28% or higher AM2 conversion efficiency at 500 to 1000 suns. The work to be performed is subdivided into the five major tasks: (1) develop and demonstrate the technology for a grading layer of GaInAs/GaAs and low-bandgap cells in AlGaInAs/GaInAs/GaAs; (2) develop and demonstrate inter-cell tunnel junction contacts in the higher bandgap AlGaInAs alloys; (3) develop and demonstrate technology for a higher bandgap concentrator cell in AlGaInAs alloys; (4) demonstrate a complete two-gap monolithic concentrator cell with Am2 efficiency of 28% or more; and (5) investigate the potential of AlInAsSb alloys grown on InAs substrates. Progress is reported.

36311 (SERI/TR—8033-2-T1) **Cadmium sulfide/copper sulfide heterojunction cell research. Final report, February 26, 1979-July 15, 1980.** Thornton, J.A.; Cornog, D.G. (TELIC Corp., Santa Monica, CA (USA)). 30 Jun 1980. Contract AC02-77CH00178. 64p. NTIS, PC A04/MF A01.

Extensive modifications were made to the multi-source deposition apparatus. These include the installation of a larger vacuum chamber on the existing system. The new chamber provides improved inter-source shielding, an improved substrate mounting and heating system, and a vacuum interlock for introducing substrates. CdS resistivity control by both In doping and off-stoichiometric deposition has been investigated. Indium doping has been achieved both by diffusion from a pre-deposited In layer and by using In doped sputtering targets. Resistivities in the range 0.1 to 5 Ω-cm have been obtained for target doping levels of from 0.1 to 1 at. percent of In. These resistivities were found to be critically dependent on the H_2S injection rate, apparently because of compensation by Cd vacancies. Off-stoichiometry CdS coatings with solar-illuminated resistivities of about 10^2 Ω-cm have been deposited, using a cyclic reactive sputtering process were the H_2S injection is periodically switched on and off. The Cu/sub x/S deposition process was found to be sensitive to the period of cathode operation prior to coating deposition, probably because of the conditioning of cathode and shield surfaces. All-sputter-deposited Cd(Zn)S/Cu_2S cells, with Cd(Zn)S layers deposited using a Cd-0.10 Zn target doped with 2 atomic percent In, have yielded efficiencies of $\sim$ 0.4%. All-sputtered cells with efficiencies of $\sim$ 0.6% have been fabricated, using undoped CdS deposited by the pulse injection process. Efficiencies of $\sim$ 1.2% have been achieved for cells with undoped sputter-deposited CdS and CuCl dry processed Cu_2S.

36312 Measurement of concentrator solar cell series resistance by flash testing. Chaffin, R.J.; Osbourn, G.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-DP00789. *Appl. Phys. Lett.*: **37**: No. 7, 637-639(1 Oct 1980).

A simple technique for the measurement of series resistance of concentrator solar (photovoltaic) cells is described. This technique makes use of the fact that the "short circuit" current of a solar cell as a function of light intensity will begin to saturate at an intensity determined by the series resistance of the cell and circuit. In this

region the series resistance of the cell can easily be found from a measurement which is relatively independent of illumination intensity and spectrum. Experimental data are presented that verify this result.

36313 Generator panel having solar cells incorporated in a laminated assembly . Tourneux, M. (to U S Philips Corp). US Patent 4,210,462. 1 Jul 1980. Priority date 24 Jun 1977, France, vpp.

A description is given of a photovoltaic genrator panel which comprises a plurality of lamellar elements, the two external lamellar elements being formed of a vitreous material, at least one of said vitreou S material lamellar element being transparent; an inner lamellar element provided with a plurality of openings, said inner lamellar element being formed of a synthetic resin having a softening temperature about 70°C.; a solar cell positioned in each such opening, the thickness of the inner lamellar element being slightly greater than that of the solar cells; and a transparent adhesive bonding said lamellar elements and said solar cells together, said adhesive being a synthetic resin formed from a monomer polymerized at a temperature below 70°C.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 36201, 36202, 36203, 36471, 36777, 36854, 37196

36314 Fluidized bed gasification presented before Wood Energy Workshop at 1980 North American Sawmill and Panel Clinic and Machinery Show. Coeur d'Alene, ID: Energy Products of Idaho ([nd]). 7p. (NP—25130). Energy Products of Idaho, Coeur d'Alene, ID.

Application of fluidized-bed gasification to the wood products industry is evaluated. Advatages over fluidized-bed combustion are listed. Progress made by the Energy Products of Idaho Company in the area of pyrolysis and gasifiction is discussed. The effort was directed toward the development of a fluidized bed process for the production of charcoal suitable for briquets. The author concludes that the application potential for the fluidized bed gasification system is very large in the wood products industry. (DMC)

36315 (CONF-7805214—(Vol.1)) **Proceedings of the First Biotechnology Conference on Biomass and Energy.** (Massey Univ., Palmerston North (New Zealand). Dept. of Biotechnology). May 1978. 133p. NTIS (US Sales Only), PC A07/MF A01.

From 1. biotechnology conference on biomass and energy; Palmerston North, New Zealand (24 May 1978).

The proceedings of a conference addressing the use of renewable energy sources in New Zealand are presented. Separate abstracts of individual presentations are prepared for inclusion in the Energy Data Base. (DMC)

36316 (CONF-7805214—(Vol.2)) **Proceedings of the First Biotechnology Conference on Biomass and Energy.** (Massey Univ., Palmerston North (New Zealand). Dept. of Biotechnology). May 1978. 125p. NTIS (US Sales Only), PC A06/MF A01.

From 1. biotechnology conference on biomass and energy; Palmerston North, New Zealand (24 May 1978).

The proceedings of a conference addressing the use of renewable energy sources in New Zealand are presented. Separate abstracts of individual presentations are prepared for inclusion in the Energy Data Base. (DMC)

36317 (CONF-7805214—(Vol.3)) **Proceedings of the First Biotechnology Conference on Biomass and Energy.** (Massey Univ., Palmerston North (New Zealand). Dept. of Biotechnology). May 1978. 97p. NTIS (US Sales Only), PC A05/MF A01.

From 1. biotechnology conference on biomass and energy; Palmerston North, New Zealand (24 May 1978).

The proceedings of a conference addressing the use of renewable energy sources in New Zealand are presented. Separate abstracts of individual presentations are prepared for inclusion in the Energy Data Base. (DMC)

36318 (CONF-790313—1) **Genetic potential and restraints in Saccharum as an energy source.** Irvine, J.E.; Benda, G.T.A. (Department of Agriculture, Houma, LA (USA). Sugarcane Field Lab.). 1979. 10p. TIC.

From Symposium on alternate uses of sugarcane for development in Puerto Rico; San Juan, Puerto Rico (26 Mar 1979).

Ways of improving the energy-gathering ability of sugar cane are discussed. Spacing, growth constraints, yields, genetic potential, and selection of varieties for an energy crop are discussed. (MHR)

36319 (DOE/ET/20481—4) **Selective solvents extraction in utilization of stored solar energy in cellulosic biomass. Final report, January 1, 1978-December 31, 1979.** Tsao, G.T. (Purdue Univ., Lafayette, IN (USA)). 1 Jul 1980. Contract AC02-78ET20481. 292p. NTIS, PC A13/MF A01.

Work on cellulose utilization at Purdue has emphasized pretreatment of lignocellulosic materials with various cellulose solvents to enhance the rate and extent of cellulose conversion to glucose. The following subtasks are discussed: the mechanism of cellulose solvents in dissolving cellulose; the hydrolysis of solvent-treated cellulose; aqueous gel permeation chromatography; membrane reactor for enzymatic hydrolysis of cellobiose; and the fermentation of corn stover hemicellulose hydrolysates to butanediol and ethanol. (DC)

36320 (DOE/PE—03871-01, pp 7.1-7.28) **Sources of biomass and their direct conversion to energy.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The types of biomass available for conversion or direct combustion are described. Land requirements and the cost of production as estimated by MITRE are presented. Aquatic crops are also considered. The use of agricultural and municipal solid wastes in energy production is discussed. Techniques used in biomass combustion are described. These include: fluidized-bed combustion, stoker and suspension firing, and steam generation. Various types of boilers and incinerators available are described. Wood-fired power plants in use at the present time and plans for future installations are described. The economics of energy conversion from biomass and municipal solid waste are considered. Environmental concerns about implementing municipal waste technologies are discussed. (DMC)

36321 (DOE/PE—03871-01, pp 9.1-9.17) **Energy from biomass via bioconversion processes.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The production of methane and ethanol from biomass is discussed. The anaerobic digestion of animal residues and biomass is described. Methane production from sanitary landfills is also described. A discussion on the production of ethanol by the fermentation of biomass crops and agricultural residues is presented. The economics of both processes are analyzed. (DMC)

36322 (DOE/TIC—11250) **Fuels and chemicals from woody biomass program. Seventh quarterly progress report.** (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 218p. NTIS, PC A10/MF A01.

Work accomplished this quarter was related to maintenance and measurement of field plots in the spring of the second growing season and involves survival counts, mortality replacement, fertilizer applications and weed control. Progress is reviewed on species screening and genetic selection, stand establishment and management, and harvest, collection, transport, and storage. Quarterly reports from individual contractors are appended. A separate abstract was prepared for one final report. (MHR)

36323 (DOE/TIC—11250, pp 46 p, Paper 2) **Recovery of aboveground woody biomass using operational modifications of conventional harvesting systems. Final report.** Herschelman, J.W.; Domenech, D.W. (Alabama A and M Univ., Normal). Jun 1980.

In Fuels and chemicals from woody biomass program. Seventh quarterly progress report.

Production and fuel consumption rates for whole tree harvesting systems using various equipment and techniques are presented. An economic analysis of these same systems is also included. Forty-eight equations were developed for hardwood trees associated with the oak-hickory forest type in the Southern Appalachian Region. Sawlog weight equations are also presented for hardwood species and species groups. Fuel consumption rates for various types of logging equipment and systems are presented.

36324 (DOE/TIC—11254) **Fuels and chemicals from woody biomass program. Sixth quarterly progress report, September-December 1979. Summary. Contractor quarterly reports.** (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 93p. NTIS, PC A05/MF A01.

The project quarterly reports are presented under the following categories: species selection, stand establishment, cultural treatments and management alternatives, and harvest, collection, transport, and storage. (MHR)

36325 Effect of temcerature on methane fermentation kinetics of beef cattle manure. Chen, Y.R.; Varel, V.H.; Hashimoto, A.G. Clay City, NE: Department of Agriculture (1979). 26p. (NP—25115).

The results indicate that ultimate methane yield (B_0) and kinetic parameter (K) did not vary with fermentation temperature for temperatures ranging from 30 to 65°C. B_0 of beef cattle manure used in this study was found to range from 0.31 to 0.34 L CH_4/g VS. The averaged K value was found to be about 0.9. This agrees with the previous conclusion that K averaged 0.9 for anaerobic fermentation of livestock manures with low influent concentrations. The results show that the growth rate of microorganisms (μm) increased from 0.284 day^{-1} for 30°C to 0.618 day^{-1} for 60°C, and then dropped to 0.313 day^{-1} for 65°C. This study did not show any optimum

kinetic rate at 42°C as postulated previously based mainly on Pfeffer's data on anaerobic fermentation of municipal refuses. When operating at the same retention time B_0 and volumetric methane yield γ/sub V/ followed the same trend as μm did when temperature was varied. However, at long retention time, the effect of temperature on B_0 and γ/sub V/ was not obvious, whereas at short retention time, the effect was profound. This study shows that there was little kinetic advantage in operating a fermentor at 60°C versus 50°C. However, there is kinetic advantage in operating a fermentor at thermophilic over mesophilic temperatures for short retention times. γ/sub V//sub max/ at 60°C is 90% higher than that at 35°C. The kinetic constants, μm and K, obtained in this study closely predicted the γ/sub V/ reported for pilot- and full-scale fermentation systems for livestock manures.

36326 (NP—25005, pp 8p, Paper 10) **Biomass as an alternate source of energy.** Parikh, P.P. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The utilization of solar energy by photosynthesis in plants is discussed. The mechanisms involved in photosynthesis are briefly explained. The advantages of energy plantations are presented. (DMC)

36327 (NP—25005, pp 11p, Paper 12) **Energy plantation.** Magal, B.S. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

An appraisal of the merits of harnessing solar energy by storing it in energy plantations is presented. The status of fossil and nuclear fuels in India necessitates the search for alternate energy sources for later use. The design and management of energy plantations are described. The annual yield per acre, the cost of fuel produced, and land requirements and availability for energy plantations in India are discussed. The short and long range benefits are presented. (DMC)

36328 (NP—25005, pp 11p, Paper 13) **Gobar gas plants.** Mital, C.K. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The Gobar Gas Plants in India are described. Various aspects of biogas are discussed including: composition; generation; plant construction; utilization; and various problems associated with these plants. (DMC)

36329 **Sixth annual lightwood research conference.** Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979). 156p. (CONF-790183—).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Twenty-one papers are included. Separate abstracts were prepared for each paper. (MHR)

36330 **Kelp growth on an ocean farm in relation to fertilizing.** Gerard, V.A.; North, W.J. Corona del Mar, CA; California Institute of Technology (1980). 7p. (CONF-800866—1).

From 10. international seaweed symposium; Gothenburg, Sweden (Aug 1980).

Results of fertilizing experiments on the test farm supported previous evidence that low macronutrient supplies limit kelp growth in offshore surface water. Enhanced N contents of blade tissues from adult and juvenile plants and enhanced growth of juvenile plants indicates that artificially upwelled deep water could provide a suitable source of nutrients. However, measurement of harvestable production depends on our ability to prevent damage to plants by currents and abrasion, which would be edge effects on a large-scale ocean farm. Three adult Macrocystis plants have been held successfully on the test farm for one year by locating them away from major structural elements. At least ten times that many plants, suitably protected and fertilized with deep water, are necessary to accomplish the immediate goal of determining yield. The test farm is now being redesigned to meet these requirements.

36331 **Assess feasibility of converting waste to methane gas in the Crystal City, Texas area. Final report to the U.S. Department of Agriculture Farmers Home Administration.** Turnacliff, W. Arvada, CO; Bio-Gas of Colorado, Inc. (1979). 18p. (NP—25119).

Five different waste sources were identified and inventoried. Over fifty tons of dry solids are available per day with 86% coming from one 11,000 head feedlot. Seven percent comes from the local Del Monte Corp. cannery and the remaining 7% comes from municipal solid waste, sewage, and gin trash. Past natural gas consumption figures show annual consumption from 70 million ft^3 to an estimated 110 million ft^3. Crystal City has been without natural gas service for over a year since August 1977. Weatherization and solar programs plus a community awareness of conservation will greatly affect future energy demands and a demand of 70 million ft^3 per year was estimated for the city's future needs. In the preliminary design, 33.9 ton per day of volatile solids are estimated to produce 237,300 ft^3 of methane a day. The two digesters total 2.54 million gallons and the retention time varies from 16.5 to 20.7 days. System heat requirements consume 29% of the energy produced and the net gas production is 5.1 million cubic feet per month or 61.65 million ft^3 per year. The digester effluent is dewatered and approximately 27 tons of residue is available each day for use as a cattle feed. The costs were developed by using Bio-Gas of Colorado's report, Energy Potential through Bio-Conversion of Agricultural Wastes - Phase II, as a guide. The total required investment under municipal ownership was $4,489,000. Total annual production costs were $663,000. Financing was considered as 5% interest for 38 years. The revenue available from the sale of residue is $463,000. Gas revenue must satisfy the remaining $200,000 of annual production costs and the methane cost becomes $3.24 per MCF. If annual production costs can be reduced by 10%, the methane cost becomes $2.17 per MCF.

36332 **Additional observations on utilization of reserve carbohydrates in paraquet induced resinosis.** Brown, C.L.; Sommer, H.E.; Birchem, R. (Univ. of Georgia, Athens). pp 4-11 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Blocking the downward translocation of current photosynthate by imposing deep transverse saw-cuts at 1.0 and 0.25 meters above paraquat treated xylem faces of slash pine (Pinus elliottii Engelm.) does not prevent resin soaking of the xylem at and above the treatment site. Transverse cuts placed at 0.25 meter directly above and below the treated face significantly reduce the amount of resin soaking apparently by reducing the contributory length of the bole in mobilizing and transporting reserve precursors to the paraquat induced sink. Defoliation of young paraquat treated trees significantly reduces the amount of oleoresin produced at and above the xylem treated face; however, the defoliated trees still produced over 50% as much oleoresin as the treated foliated controls during the 5-month period following treatment. These observations along with light and electron microscope studies indicate that reserve foods contribute a significant amount of carbon precursors utilized in paraquat induced oleoresin formation.

36333 **Carbon fixation and enzyme activities in Virginia pine after paraquat treatment: a preliminary report.** Ryan, F.J. (Comparative Animal Research Lab., Oak Ridge, TN); Schwarz, O.J. pp 12-20 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Photosynthetic carbon fixation has been measured in 3-year-old Virginia pine (P. virginiana) treated with paraquat (2 mg/tree). The trees were assayed periodically (11 sampling times) for 30 days after treatment at which time essentially all photosynthetic capacity ceased. Paraquat treatment did not appear to alter the distribution of fixed carbon (current photosynthate) between ethanol soluble and starch fractions. Peroxidase activity was demonstrated in acetone powder preparations of needle and stem tissue of control and paraquat-treated trees. Preliminary data suggest that paraquat treatment increases the level of peroxidase activity.

36334 **Effects of paraquat treatment on height growth, branch extension, and cambial activity of loblolly pine.** Nix, L.E. (Clemson Univ., SC). pp 21-27 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Pulpwood-sized loblolly pines located in the Piedmont of South Carolina were treated with 4% paraquat applied to wounds encompassing one-half their basal circumference prior to the active growing season. Height growth, branch extension, and cambial activity were monitored for 2 years after treatment. Neither height growth nor branch extension were affected by the paraquat treatment. Cambial activity was reduced in a decreasing gradient up the bole of treated trees with greatest inhibition occurring on the treated side. Compensatory cambial activity occurred on the lower side opposite the treatment but did not extend appreciably up the bole. Cambial inhibition on both treated and untreated sides resulted in a 24% reduction in volume growth of treated trees. Cambial necrosis extended 16 ft above the treatment site. Resin-soaking was not appreciable above 8 ft, and abnormal cellular differentiation (traumatic resin ducts) was not observed above 20 ft.

36335 **Culture growth inhibition of selected blue stain fungal symbionts of Dendroctonus by paraquat.** Kidd, F.; Paul, S. (Colorado State Univ., Fort Collins). pp 28-38 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Paraquat of varying concentrations was incorporated into malt agar upon which pure culture isolates of selected bark beetle blue stain symbionts and fungi isolated from paraquat-treated slash pine were grown. Fungal growth of all species was inhibited as paraquat concentration increased, but fungi demonstrated a species specific paraquat tolerance. Growth of fungi from slash pine was nearly identical to that of controls at a concentration of paraquat (64 ppM) that was totally inhibitory to all other fungi.

36336 Insect problems and control measures. Clark, E.W. (USDA Forest Service, Olustee, FL). pp 40 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Reasons for insect attact after paraquat treatment and methods for dealing with them are discussed briefly.

36337 Insecticide control in Florida: a progress report. Williams, I.L. Jr. (USDA Forest Service, Olustee, FL). pp 41-47 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Lindane, the only registered insecticide for control of bark beetles on southern pines, has proven to be superior to any other insecticide when inducing lightwood by paraquat application. Chlorpyrifos does show promise as an alternate to lindane and is a candidate for registration in controlling bark beetles.

36338 Minimizing insecticide requirements in the paraquat induction of resinosis. Moore, G.E. (USDA Forest Service, Raleigh, NC); Stubbs, J.; Outcalt, K.W. pp 49-55 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

A factorial study was installed in loblolly pine plantations in the Upper Coastal Plain of South Carolina to determine whether selected paraquat treatments with little or no insecticide could produce acceptable lightwood without undue losses from bark beetles. Results indicate that such treatments can be successfully and economically applied within the geographic region of the study and in contiguous areas in Georgia. The most promising treatments without an insecticde spray are 2 or 5% paraquat (or 2% paraquat with Ethrel) applied to bark streaks made with a power chipper or 2% paraquat (with or without Ethrel) applied with a tree injector.

36339 Insect attack and tree mortality in paraquat-treated stands at the Savannah River Plant. Outcalt, K.W.; Stubbs, J. (USDA Forest Service, Aiken, SC). pp 56-64 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Data was collected on bark beetle infestation and associated tree mortality from studies of lightwood induction with paraquat at the Savannah River Plant. Loblolly pine mortality following dowel treatments was excessive: 31 and 90% for one and two dowels per tree, respectively. On loblolly pines sprayed with 0.1% BHC, application of 5% paraquat solution to 1/3-circumference bark streaks caused no additional mortality over natural levels. Slash pine treated with a Jim-Gem injector and 2% paraquat had a sizable increase in mortality and second growing season, bringing the total volume loss after 15 months to 10%. In loblolly pines, the season in which a 2 or 5% solution of paraquat was applied to 1.3-circumference bark streak did not influence mortality, which was low for all seasons. Sprays of BHC, Dursban (chlorpyrifos) and Reldan (chlorpyrifos-methyl) were equally effective but unnecessary, because mortality increased by only 3.8% when no insecticide spray was applied. Beetle attack and associated tree mortality increased as the concentration of paraquat solutions increased.

36340 Screening modern insecticides for control of black turpentine. Kislow, C.J.; Jones, A.S.; Hastings, F.L. (USDA Forest Service, Research Triangle Park, NC). pp 65-68 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Contact toxicity data are presented for 10 insecticides against two Ips species: I. grandicollis (Eichh.) and I. calligraphus (Germ.). Preliminary toxicity results are also included for I. avulsus (Eichhoff) and the black turpentine beetle, Dendroctonus terebrans (Olivier). Field bioassay data indicate that both chlorpyrifos (Dursban) and fenitrothion (Sumithion) could reduce beetle emergence from infested trees.

36341 Lightwood induction by paraquat and diquat applied with ethrel. Peters, W.J.; Roberts, D.R.; Munson, J.W. (USDA Forest Service, Olustee, FL). pp 70-77 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Similar amounts of lightwood were observed one year after treatment of slash pine (Pinus elliottii Engelm. var. elliottii) with 2% paraquat or 2% diquat in combinaton with 0, 5, 10, or 15% 2-chloroethylphosphonic acid (Ethrel). In the first 3-m bolt, yield of resin acids in treated trees was 4.5 to 5.4 times greater and turpentine yield was 5.5 to 10.9 times greater than yields from the controls. There was no quantitative increase in resin acids or turpentine in the second 3-m bolt or in the remaining merchantable bole of the tree. Although small increases were observed with the addition of Ethrel, the stimulation of oleoresin was apparently maximized even without it.

36342 Short-term production of lightwood without insecticides. Roberts, D.R. (USDA Forest Service, Olustee, FL). pp 78-81 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Experiments involving injections of paraquat into threes indicate that large increases in resin acids and turpentine can be produced in a 3-month period without insecticide spray. Trees treated with 2% paraquat yielded 50% more resin acids and 100% more turpentine than untreated trees.

36343 SCM field experiments with paraquat substitutes. Joyce, E.R. (SCM Corp., Jacksonville, FL); Drew, J. pp 82-103 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

The results of five years of experimental work searching for substitutes or synergists for paraquat treatment of pine trees for oleoresin enhancement are reported. Several chemicals tested showed enhancement, but none was as effective as paraquat. Several chemicals when added with paraquat in the treatment showed a synergistic or additive effect on oleoresin enhancement.

36344 Paraquat induced oleoresin biogenesis in a thinned loblolly pine stand: second year results. Clason, T.R. (North Louisiana Hill Farm Experiment Station, Homer, LA). pp 104-106 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Second year results from paraquat treated low vigor trees designated for harvest in five years are presented. In 1978, six more plots of trees were paraquat treated. Volume growth for the 1977, 1978, and control treatments was 35, 50, and 76 ft^3/A. Mortality in the 1977 and 1978 treatments was 5 and 7 trees. Oleoresin levels increased by 10 fold but were significantly influenced by the presence of blue stain fungi.

36345 Methods of applying paraquat in planted slash pines. Roberts, D.R. (USDA Forest Service, Olustee, FL). pp 107-110 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Nine methods involving three types of wounds (bark streak, drill hole, and injections) were used to apply paraquat to 19-year-old slash pine (Pinus elliottii Engelm. var. elliottii) trees. Trees harvested 1 year later indicated that oleoresin yield was not affected by application methods. All methods greatly increased tree yields of turpentine and resin acids. Insect attacks were severe and resulted in greater than 25% mortality from all treatments in 1 year. More than 50% of the trees died with two of the nine application methods.

36346 Tools for commercial treatment. Mappin, H.; Propst, M. (Hercules Inc., Brunswick, GA). pp 112-114 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Treatment of trees with paraquat has been accomplished with mostly manual labor. Future commercialization of the process will require mechanization in order to attract sufficient labor and to optimize costs. A technique for application of paraquat from a small tracked vehicle is described.

36347 Large scale sampling techniques. Pombo, M.M. (Hercules Inc., Wilmington, DE); Propst, M. pp 115-119 of Sixth annual

lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Analytical data indicates that a minimum of 50 trees is needed to provide an adequate sample for yield and economic studies. Techniques and equipment used in selecting and handling the large samples are described.

36348 Turpentine extraction and analysis with an internal standard. Munson, J.W. (USDA Forest Service, Olustee, FL). pp 120-124 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Turpentine extraction and analysis can be effectively performed with small samples if an internal standard is added. Turpentine yield and composition can then be evaluated simultanesouly by gas liquid chromatography.

36349 Effect of paraquat-treated pulpwood on kraft pulp and papermill operations. Jonakin, J.L. (Continental Forest Industries, Augusta, GA); Millard, E.C. pp 125-137 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

In a joint research study with the US Forest Service and the Department of Energy, approximately 39,000 twenty-three year old loblolly pines were treated with paraquat by the 1/3 circumference bark wound method to induce abnormal oleoresin generation within the trees. Aproximately fifteen months after treatment, 4480 cords of pulpwood were harvested and processed during a twenty-five day period through the batch digesters of the C.F.I. kraft pulp and papermill at Port Wentworth, Georgia. The treatment method employed resulted in no abnormal tree mortality nor were papermill processes or products adversely affected during the trial period. By-product chemical recovery systems yielded about 40% more tall oil from treated wood than from untreated. The potential for a similar turpentine yield increase was at least as great; however, process systems could not efficiently recover the amount generated. Based on mill yield levels measured during the study, present by-product chemical prices and US Forest Service treatment figures, increased sales revenue will barely off-set tree treatment costs. Higher by-product chemical prices and lower cost treatment methods might generate substantial income, particularly if recovery systems were optimized for higher feed rates.

36350 Economics of commercial application of paraquat. Drew, J. (Drew Forest Chemicals Lab., Jacksonville, FL); Joyce, E. pp 138-146 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

Calculations based on actual studies show that kraft pulp mills can make an attractive profit by processing paraquat treated wood. An increase of up to 1.5 million dollars per year might be achieved by a mill processing 1000 cords per day of paraquat treated slash pine. Roundwood storage is important in handling treated wood, especially loblolly pine wood.

36351 Potential health hazard associated with determination of turpentine in wood. Zinkel, D.F. (Forest Products Lab., Madison, WI). pp 147-149 of Sixth annual lightwood research conference. Esser, M.H. (ed. and comp.). Asheville, NC; Southeastern Forest Experiment Station (1979).

From 6. annual lightwood research conference; Atlanta, GA, USA (17 Jan 1979).

A health hazard may be present in the usual method for determining turpentine in conifer wood. During the distillation, volatile, toxic byproducts are produced and partly emitted from the condenser. Two of the byproduct components have been idenified as acylfurans.

36352 Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978). 216p. (CONF-780178—).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Twenty-eight papers are included. Separate abstracts were prepared for each one. (MHR)

36353 Paraquat and pine trees in East Tennessee. Schnell, R.L.; Toennisson, R.L. (Tennessee Valley Authority, Norris). pp 4-7 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The Tennessee Valley Authority started a series of 8 percent Paraquat tests in East Tennessee on loblolly, shortleaf, and Virginia pines in the spring of 1974. In addition to species, the effects of season of treatment application and the length of time between the completed treatment and the harvest cut are being tested. Wood samples are being analyzed. All three species have shown increased oleoresin production. Season of treatment did not have a significant effect on enhancement nor did length of time between treatment and harvest.

36354 Tall oil and turpentine analyses of Virginia and loblolly pines treated with paraquat in East Tennessee. Holton, R.W. (Univ. of Tennessee, Knoxville). pp 8-13 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Analyses of tall oil and turpentine have been completed for the one and two year periods following treatment of two pine species with 8% paraquat, and the results have been analyzed statistically. The conclusions which can be drawn at this point in the study are that yields are not enhanced for either Virginia or loblolly pines over the longer time period nor is there a difference in yields in treatments initiated in the four different seasons. Turpentine and rosin acid yields decrease in the bolts farthest away from the wound but fatty acids do not show that pattern and appear to be in lowest content at the wound. This coupled with preliminary data on control trees suggests that paraquat treatment could cause a redistribution of carbon skeletons from fatty acids to rosin acids and turpentine.

36355 Utilization of paraquat in a silvicultural thinning regime: first year results. Clason, T.R. (North Louisiana Hill Farm Experiment Station, Homer). pp 14-18 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

In a recently thinned 20-year-old loblolly pine stand, paraquat was applied to low vigor trees designated for harvest in five years. Trees received 10 ml of a 6000 ppM paraquat solution at each of two frills placed horizontally on the tree, one, 90 cm above the other. After one growing season, diameter growth of treated trees averaged 20 percent less than control low vigor trees, survival rate was 100 percent, bark beetle infestations were minimal, and oleoresin levels increased 10 fold. Application costs were estimated at $37.01 per acre.

36356 Lightwood as a source of unusual naval stores chemicals. Zavarin, E.; Wong, Y.; Zinkel, D.F. (Univ. of California, Richmond). pp 19-30 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Sugar pine and western white pine contain unusual labdane-type resin acids which could be the source of novel fine chemical, naval stores products by means of induced lightwood technology. Analysis of trees one season after paraquat treatment showed the effect to be limited to the sapwood in the first two meters above the treatment zone. Although there was a significant increase in the amount of oleoresin, no change in resin acid composition was seen. In all three pines, the amounts of volatile materials increased in the zones affected by paraquat. In western white pine and in sugar pine the main volatile components were α- and β-pinenes; the lightered wood produced turpentines slightly richer in α-pinene. The volatiles of Jeffrey pine contained mainly n-heptane, α-pinene, β-pinene, and 3-carene. In the lightered wood the volatiles contained more n-heptane, although its amounts never reached the high percentages ($>95\%$) reported for the gum oleoresins. N-pentane, never reported before in pine oleoresins, was identified as a secondary constituent of Jeffrey pine wood oleoresin.

36357 Ethrel-diquat-paraquat interaction in lightwood formation. Peters, W.J.; Roberts, D.R.; Munson, J.W. (Southeastern Forest Experiment Station, Olustee, FL). pp 31-39 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The amount of lightwood produced in slash pines (Pinus elliottii Engelm. var. elliottii) after paraquat or diquat was placed in bored holes was increased by adding Ethrel to the herbicide solutions. With both herbicides, the amount of oleoresin enhancement increased with increasing bipyridilium concentration. Results suggested that the effect of Ethrel was more than additive. The highest concentrations of herbicide with Ethrel produced extractives yields 2.5 times those in control trees 1.6 years after treatment.

36358 Short method for estimating increases in wood extractives from lightwood induction treatments. Squillace, A.E.; Moyer, E. (Southeastern Forest Experiment Station, Olustee, FL). pp 40-49 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The amount of resin soaking in paraquat-treated pines can be reliably estimated from the difference in density (oven dry weight, green volume basis) of the treated and untreated sides of stems or of whole stems of genetically identical trees. The procedure eliminates the need for extraction. Yields based on increases in unextracted density of cores taken at 5 height levels (-0.30, 0.00, 0.61, 1.22, and 2.44 m, or -10, 2, 4, and 8 feet above the wound) were strongly correlated with the increase in extractives content obtained by alcohol-benzene extraction ($r = 0.95$), with only slight underestimates being obtained. Sampling at only 2 levels (0.61 and 2.44 m, or 2 and 8 feet) above the wound may be sufficiently reliable for rough estimates ($r = 0.84$).

36359 Paraquat treatment reduces wood density after alcohol-benzene extraction. Squillace, A.E. (Southeastern Forest Experiment Station, Olustee, FL). pp 50-53 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Treatment of slash pine with paraquat to induce resin-soaking caused a reduction in density of extracted wood in the lower boles of both the treated and untreated sides of treated trees (especially the former) in comparison with that of control trees. The reduction in density was probably caused by conversion of parenchymal substances (such as starches and proteins) insoluble in alcohol-benzene solution into soluble materials and subsequently into oleoresins, which in turn were removed by alcohol-benzene extraction. Increase in resin yield following paraquat treatment is probably partly due to such conversions.

36360 Integrated chemical system for whole-tree utilization of paraquat-treated pines. O'Neil, D.J. (Georgia Inst. of Tech., Atlanta). Contract EG-77-S-05-5543. pp 54-65 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

An approach to the development of an integrated chemical process system for utilization of whole or complete paraquat-treated pine trees is described. The efficient extraction of oleoresinous hydrocarbons is an essential element in the economic development of an integrated, multi-product silvichemical plant. The major elements of the system are described.

36361 New tool for paraquat application. Roberts, D.R. (Southeastern Forest Experiment Station, Olustee, FL). pp 66-67 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

A new tool for applying paraquat solutions to pine trees has been developed from a modified grease gun by Forest Service scientists and technicians at Olustee, Florida. This tool places the solution between the wood and the bark in the same way that the Med-E-Jet injector does but is cheaper and easier to operate. It is also suitable for applying other chemical solutions including insecticides, fungicides, and other herbicides.

36362 Bark beetles in paraquat treated pines. Drew, J. (Glidden-Durkee, Div. of SCM, Jacksonville, FL). pp 70-81 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The attraction of bark beetles to paraquat treated pines continues to be of major concern. A summary of observations reported in two questionnaire surveys, one year apart, is given. Many observers report that infested trees throw-off black turpentine and Ips beetles with time. There is no reported spread of beetle activity to adjacent stands of untreated trees. Several insect repellents and U.V. screening agents were not effective in reducing beetle attack. Pheromones, verbenone and trans-verbenol, appear effective as repellents in preliminary tests, especially against Ips beetles. Ethrel is reported to promote oleoresin formation without the insect attraction experienced from paraquat enhancement. Beetles, per se, cause oleoresin enhancement.

36363 Effect of season of paraquat application and different insecticides on bark beetle-caused slash pine mortality. Merkel, E.P. (Southeastern Forest Experiment Station, Olustee, FL). pp 82 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

36364 Survival of Ips and dendroctonus terebrans in pines treated with paraquat by streak and dowel methods. Moore, G.E. (Southeastern Forest Experiment Station, Research Triangle Park, NC). pp 83-87 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Ninety-six beetle-infested trees that had been treated with paraquat were examined; 16 had been sprayed with insecticide after paraquat application and 80 had not. Brood survival in bark plus emergence of brood averaged 22 percent for Ips calligraphus (Germ.) and 98 percent for Dendroctonus terebrans (Oliv.) in these trees. Spraying insecticide on the lower 4 m of tree boles after paraquat application reduced the number of successful attacks by bark beetles but did not influence brood survival if an attack was successful. Survival of attacked trees 9 months after treatment was high when paraquat was applied by the bark-streak method. It was low when paraquat-impregnated dowels were placed in holes bored intree boles. Mortality after this treatment appeared to be caused primarily by the paraquat.

36365 Beetle response to, and development in, paraquat treated slash pine. Goldman, S.E.; Parker, J.A. (International Paper Co., Bainbridge, GA). pp 88-89 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

To further understand the relationship between Paraquat induced lightwood formation and associated beetle attack this study was designed to: 1) determine the feasibility of lightwood induction in slash pine (Pinus elliottii var. elliottii Engelm.) and minimize beetle attack, without insecticide treatment, by altering treatment methods or application time; 2) identify the beetles (Coleoptera) associated with lightwood induction; and 3) determine whether black turpentine beetle (BTB) (Dendroctonus terebrans (Oliv.)) and pine engraver beetle (Ips spp.) brood development occurs within lightwood induced trees.

36366 Resistance of paraquat-treated wood to termites, decay fungi, and marine borers. Beal, R.H. (Southern Forest Experiment Station, Gulfport, MS); Amburgey, T.L.; Carter, F.L.; Roberts, D.R.; Bultman, J.D. pp 90-91 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Results are summarized from two cooperative studies (1, 2) between the Southern and Southeastern Forest Experiment Stations and the Naval Research Laboratory. In laboratory and field studies lightwood (resin-soaked) was compared with nonresin-soaked wood for resistance to subterranean termites, decay fungi, and marine borers. A brief discussion of methods and results is presented.

36367 First standard LRCC study: procedures. Beers, W.L., Jr. (Buckeye Cellulose Corp., Perry, FL). pp 94-95 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Procedures are described for uniform lightwood induction tests installed in 1974 in slash and loblolly pine plantations in South Carolina, Georgia, and Florida.

36368 First standard LRCC study - results. Draper, L., Jr. (Container Corp. of America, Callahan, FL). pp 96-100 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Planted slash pine age 15 and 24 years located in Nassau County, Florida, were treated with 8% paraquat solution. Eighteen months after treatment whole tree turpentine and resin acid yields were increased a minimum of 200% and 73% respectively. Tree age did not influence yield. The turpentine produced as a result of paraquat treatment was enriched in terms of B-pinene. Insect damage was more severe in the younger (15-year-old) stand.

36369 First standard LRCC study. Gill, J.J. (Georgia Kraft Co., Rome). pp 101-104 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The First Standard Lightwood Coordinating Council test was applied to loblolly pine, slash pine, and shortleaf pine in Middle Georgia. Paraquat was applied to one-inch streaks at 8% and 4% concentrations to induce lightering. Poor field techniques and too high concentrations of chemical resulted in excessive mortality, totally eliminating the treated shortleaf pine. Laboratory tests were run on the 8% treatment for both loblolly and slash. Indicated whole tree increases in extractives are for loblolly-tall oil 38 percent; turpentine 151 percent; for slash-tall oil 37 percent; and turpentine 187 percent. Limited sampling and extreme tree-to-tree variation indicates a need for more intensive sampling.

36370 Results of the first standard LRCC study - loblolly pine in Nassau County, Florida. Ericksen, W.D. (ITT Rayonier Inc., Fernandina Beach, FL). pp 105-109 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Two years after treatment loblolly plantations showed responses to paraquat treatment. Variability within treated and control samples confounded levels of response over time.

36371 Southwide induction of lightwood with paraquat--second LRCC standard experiment. Roberts, D.R. (Southeastern Forest Experiment Station, Olustee, FL). pp 110-115 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Cooperation, to support application for an EPA label, is reported with 19 pulp companies and TVA in a standardized study of lightwood induction with low concentrations of paraquat in stands of loblolly and slash pine in 13 southern states. Nine months after a 2 percent paraquat was sprayed on bark-chipped streaks, treated loblolly pines yielded 96 percent more rosin and 159 percent more turpentine and treated slash pines yielded 128 percent more rosin and 172 percent more turpentine than did untreated controls. Turpentine composition was altered by paraquat treatment in both species. Insect activity differed greatly among locations. Except in one stand damaged by fire, only three treated trees in this experiment died.

36372 Large scale field testing of paraquat application techniques. Stubbs, J. (Savannah River Plant, Aiken, SC). pp 116-123 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Three large proof-of-concept studies in paraquat application for lightwood induction have been installed at the US Department of Energy's Savannah River Plant. Pulpmill trials using wood from these studies are scheduled for February, May or June, and December 1978. A fourth study for a wood naval stores plant run was destroyed by too intense paraquat treatment and by Ips bark beetles. Costs of treatments, insect attacks and tree mortality, and oleoresin yields are reported here. Future plans are briefly discussed.

36373 Mill experience pulping lightwood loblolly pine. Waite, P. (Allied Paper Inc., Jackson, AL). pp 126-129 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

A mill scale pulping trial utilizing 40 and 60 percent furnishes of paraquat treated, predominantly loblolly, trees harvested six months after treatment because of insect infestation was run at Allied Paper. No significant operational problems were encountered. By-product yield increases of 0.36 to 0.46 gallons of turpentine and 9.5 to 22.4 pounds of tall oil per ton of bleached pulp production above control runs utilizing 40 and 60 percent furnishes of untreated wood from the same forest area were obtained.

36374 Oleoresin loss from stored paraquat treated wood. Joyce, E. (Glidden-Durkee, Div. of SCM, Jacksonville, FL). pp 130-132 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

The results of two studies of paraquat treated stored roundwood show less overall turpentine and tall oil losses when compared to untreated stored roundwood. There appears to be an increase in rosin acid content in the treated wood with time, but this may be due to the nature of the analysis. No difference was noted in by-product losses between barked and de-barked wood. Roundwood storage is preferred to outside chip storage.

36375 Chemistry of naval stores from pine lightwood--a critical review. Zinkel, D.F. (Dept. of Agriculture, Madison, WI); McKibben, C.R. pp 133-156 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Commercial processing of induced pine lightwood will not only recover the rosin and turpentine of the induced oleoresin but will also involve the rosin, turpentine, fatty acids, and nonsaponifiable materials originally present in the wood. This is important in that both quantity and composition of the total naval stores extractives will affect the processing and utilization of the naval stores products. The current knowledge of these naval stores chemicals from pine lightwood is assessed in this review.

36376 Chemical analyses of the extractives from the Lightwood Research Coordinating Council efficacy study. McBride, J.J. Jr. (Arizona Chemical Co., Panama City, FL). pp 157-167 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

An analytical scheme for characterizing the lightwood extractives is shown. The yields and chemical composition of the extractives are tabulated. (MHR)

36377 Economic evaluation of the paraquat application for oleoresin production in conifers. Krumbein, J.P. (Reichhold Chemicals, Inc., Pensacola, FL). pp 168-178 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

An economic evaluation of 19 plantation stands of loblolly and slash pines treated with 2% paraquat in a standard one-third circumference bark streak, and allowed to lighter for nine months prior to harvesting, indicates that the value of the additional oleoresin produced only marginally offsets the cost of treatment and other adverse effects created by the treatment. Based on the current market value of the extractives generated, the process as applied in this study does not appear to be economically viable as a method of increasing crude tall oil and sulphate turpentine production. Factors that could improve economics are presented.

36378 Efficacy studies on paraquat treated slash and loblolly pines. Enos, H.I. Jr. (Hercules, Inc., Wilmington, DE); Propst, M.E.; Pombo, M.M. pp 179-200 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

Quantitative determination of the formation of lightwood by the deposition of oleoresin in the sapwood of slash and loblolly pines following the introduction of paraquat is reported for eight locations in the southeastern United States. Suitability of the lightwood for solvent extraction to produce typical turpentine and rosin products is indicated by the composition data on the oleoresinous extracts. The average productivity of oleoresin in the five-foot treated bolt for the growing season following paraquat treatment is equal to that of the entire stem of comparable untreated trees.

36379 Report on registration of the use of paraquat CL for resin soaking in pines. Toffaleti, J.P. (Chevron Chemical Co., Richmond, CA). pp 202-204 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

36380 Status report of the USFS production of wood chemicals research work unit. Stubbs, J.; Roberts, D.R. (Southeastern Forest Experiment Station, Olustee, FL). pp 205-209 of Lightwood Research Coordinating Council annual meeting. Esser, M.H. (comp.). Asheville, NC; Southeastern Forest Experiment Station (1978).

From Lightwood Research Coordinating Council annual meeting; Atlantic Beach, FL, USA (10 Jan 1978).

A brief summary is given of staffing, funding, and plans for lightwood research by the Forest Service in Olustee, Florida, and Aiken, South Carolina. Progress is described for seven new experiments and three old ones in Olustee.

PHOTOCHEMICAL, PHOTOBIOLOGICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 37016

36381 **Study of oxide-based heterostructure photoelectrodes.** Maruska, H.P.; Ghosh, A.K. (Exxon Research and Engineering Co., Linden, NJ). *Sol. Energy Mater.;* **1**: No. 5-6, 411-429(Jun 1979).

The correlation between the external bias requirement and electron affinity of oxides comprising photoelectrodes is identified. A series of composite electrodes comprised of a stable wide band gap oxide (TiO_2, $SrTiO_3$, Al_2O_3, SnO_2) and a corrosion prone sunlight absorber (CdS, CdSe, ZnTe, Si) were fabricated and tested. Performance of heterostructure electrodes is shown to be limited either by pin hole problems or by potential barriers between the valence bands. These potential barriers can be minimized by using insulating oxide samples, with high work functions, and the photovoltaic properties of insulating $SrTiO_3$ are presented.

PHOTOVOLTAIC POWER SYSTEMS

REFER ALSO TO CITATION(S) 36229, 36231, 36232, 36235, 36236, 36237, 36238, 36239, 36240, 36241, 36242, 36243, 36244, 36245, 36246, 36247, 36248, 36249, 36250, 36251, 36252, 36253, 36254, 36255, 36256, 36257, 36258, 36259, 36260, 36261, 36262, 36263, 36264, 36265, 36266, 36267, 36268, 36269, 36270, 36271, 36272, 36273, 36274, 36275, 36276, 36277, 36278, 36279, 36280, 36281, 36282, 36283, 36284, 36285, 36286, 36287, 36288, 36289, 36471, 36487, 36623, 36624, 36625, 36626, 36627, 36628, 36629, 36630, 36631, 36632, 36633, 36634, 36635, 36636, 36740, 36741, 36742, 36780, 37243, 37244, 37245, 37246, 37247, 37273, 37274, 37275, 37276

36382 (CONF-790890—, pp C.17-C.24) **Export potential for photovolatic systems.** Smith, E. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

A preliminary assessment of the export potential of US photovoltaic products and systems is provided. The following issues deal with: the nature of the technology, the market characteristics, the size of the potential market, the size of the market share the US can expect based on past performance, the US position relative to potential foreign competition, factors determining potential success in exporting, and policy issues influencing market size and share. (MHR)

36383 (CONF-800491—) **Final proceedings of the Solar Power Satellite Program review.** (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Jul 1980. Contract FG05-79ER10116. 690p. NTIS, PC A99/MF A01.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The 171 papers and extended abstracts included in the proceeding were entered into the data base separately; short abstracts of papers and brief introductory papers were not entered separately. (WHK)

36384 (CONF-800491—, pp 1-7) **Historical perspective on the solar power satellite concept.** Glaser, P.E. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36385 (CONF-800491—, pp 15-20) **Satellite power system. Concept development and evaluation program: the assessment process.** Koomanoff, F.A. (Dept. of Energy, Washington, DC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36386 (CONF-800491—, pp 21-35) **Overview of systems definition activities for satellite power systems.** Schwenk, F.C. (NASA Headquarters, Washington, DC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36387 (CONF-800491—, pp 66-77) **Comparative assessment of the reference satellite power system with selected current, near-term and advanced energy technologies.** Riches, M.R. (Dept. of Energy, Washington, DC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The SPS Concept Development and Evaluation Program (CDEP) was established by the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA) to generate information by which a rational decision could be made regarding the direction of the Satellite Power System (SPS) program after fiscal 1980. The four functional areas within the joint DOE/NASA-CDEP are as follows: (1) systems definition: development of the SPS reference system design; (2) environmental assessment: evaluation of potential environmental effects of SPS; (3) societal assessment: evaluation of potential societal effects of SPS; and (4) comparative assessment: development of a comparative data base on the SPS and other energy systems. The results of the first three activities are inputs to the comparative assessment process as well as independent program assessments. This report concerns the Comparative Assessment portion of the DOE/NASA-CDEP. The objective of the comparative assessment is to develop a traceable comparative data base for those making decisions on the SPS and near-term and advanced energy technologies. To achieve this objective, alternative energy technologies were selected, characterized, and evaluated according to a prescribed framework. These evaluations were then integrated into a comparative assessment.

36388 (CONF-800491—, pp 78-87) **Overview on European SPS activities.** Reinhartz, K.K. (European Space Agency, Noordwijk, Netherlands). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36389 (CONF-800491—, pp 88-90) **SPS issues: the need to look ahead.** Dybdal, K.K. (St. Olaf College, Northfield, MN). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The safety, reliability, and cost-efficiency of satellite power systems are all interrelated. A reliable and safe system will be less likely to incur extra costs because of slowdowns or shutdowns. Large investments occuring early in the development phase may be offset by increases in system reliability and safety. These increases would help the systems achieve their full economic potential. Reliability, safety, and cost-efficiency are not the only issues in the SPS program, but they are important areas to examine, and a systemic approach can be a valuable tool.

36390 (CONF-800491—, pp 91-94) **SPS overview: requirements, alternatives, and reference system.** Livingston, L.E. (NASA/Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Options for power generation, rf generation, and rectennas are discussed. The reference SPS is briefly described; it consists of silicon or gallium arsenide solar cells, klystron rf power generators, and dipole receiving elements with Schottky barrier diodes. The reference system is constructed in synchronous orbit using material transported from low earth orbit by electric orbit transfer vehicles. (WHK)

36391 (CONF-800491—, pp 95-98) **Emerging SPS concepts.** Hanley, G.M.; Woodcock, G.R. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Four new technologies have recently been evaluated to determine their effect on Satellite Power System (SPS) concepts. Two of these technologies, solid-state power amplifiers and magnetrons, are replacements for the klystrons used for dc to rf conversion on the satellite. A third technology, laser power transmission, transmits the energy at laser frequencies rather than microwave frequencies. The fourth technology, multibandgap solar cells, has the promise of significantly increased solar to dc conversion efficiency as compared to the reference-concept silicon and gallium arsenide solar cells. The design characteristics of concepts resulting from application of these technologies are summarized.

36392 (CONF-800491—, pp 99-102) **Integration of SPS with utility system networks.** Kaupang, B.M. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The integration of SPS power in electric utility power systems is discussed. Specifically treated are the nature of the power output variations from the spacecraft to the rectenna, the operational characteristics of the rectenna power and the impacts on the electric utility system from utilizing SPS power to serve part of the system load.

36393 (CONF-800491—, pp 103) **SPS cost methodology and sensitivities.** Piland, R.O. (Lyndon B. Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Accurate cost estimates for any advanced energy system are very difficult to develop. All such estimates require assumptions related to technological advancement over an extended period of time. Nevertheless, the evaluation of a potential system requires such estimates, and a number of cost estimates have been developed during the Solar Power Satellite (SPS) Concept Evaluation Program. One such estimate is described for illustrative purposes. It

should be noted that no official cost estimate exists for an SPS program at the present time.

36394 (CONF-800491—, pp 107-108) **SPS technical issues.** Guttman, C.H. (NASA Marshall Space Flight Center, AL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Beginning with the earliest studies of Satellite Power Systems (SPS) engineers and scientists have consciously red flagged any technical issue which would either seriously impact or potentially negate the integrity of an SPS Program. Issues were identified not only relating to the question of engineering feasibility, but also to the equally important areas of environmental and social acceptability and, especially, economic viability. Much effort has been expended on studies and experiments directed toward obtaining an understanding of these issues and the degree to which they can be resolved. It is the intent here to enumerate technical issues which were highlighted some four years ago; to selectively discuss some of the results obtained as to their resolution; and to briefly touch on their current status.

36395 (CONF-800491—, pp 109-112) **Critical technology areas of an SPS development and the applicability of European technology.** Kassing, D.; Ruth, J. (European Space Agency, Noordwijk, Netherlands). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A possible system development and implementation scenario for the hypothetical European part of a cooperative SPS effort is discussed, and technology and systems requirements which could be used as an initial guideline for further evaluation studies are characterized. The technical analysis is based closely on current DOE/NASA SPS reference system and factors that could influence the utilization of SPS's in W. Europe. The scenario presented is not intended either as a prediction or as a recommendation, but as a tool fr further evaluations.

36396 (CONF-800491—, pp 125-128) **Evaluation of the land and material requirements for the satellite power system.** Ankerbrandt, S.D. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Current research and evaluation of the physical resources requirements for SPS concentrated on three topics: land requirements and the siting of rectenna; the environmental impacts of a rectenna siting, and the materials requirements for SPS. The first two of these topics focus exclusively on the earth-based element of the SPS while the materials assessment considered requirements for both the space and earth systems. The identification, classification, and selection of adequate areas deemed eligible for rectenna siting is critical to further consideration of the SPS reference system. Although each specific rectenna site will generate unique environmental, social, and economic impacts, the prototype environmental assessment illustrates the range of problems which may be encountered. Results of the study are reviewed.

36397 (CONF-800491—, pp 138-141) **Methodology for the comparative assessment of the SPS and alternative technologies.** Wolsko, T.D. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The objectives of the comparative methodology are to (1) establish a framework of assessment information that incorporates different comparative viewpoints, (2) develop a classification system in which the environmental, social, and economic issues can be grouped into meaningful categories for the decision maker, (3) identify the units of measure that are used to compare the environmental, social, and economic issues, (4) establish quantitative and qualitative strategies (approaches, methods, models) of data collection and analysis for an issue assessment, and (5) identify sources of data for the comparative assessment. The phased sequence of analytical steps that make up the framework for the comparative assessment is briefly described.

36398 (CONF-800491—, pp 142-145) **Reference system characterization and cost overview.** Piland. R.O. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Studies conducted during the Solar Power Satellite Concept Evaluation Program have considered a variety of system design approaches. Each of these design approaches has advantages and disadvantages. Considerable additional work would be required before a final or preferred system can be defined. For the immediate purposes of the evaluation program, however, a reference system has been defined to provide a basis for assessing alternate technical approaches, environmental factors and to serve as a basis for preliminary cost studies. Major elements of the reference system are described, and preliminary cost estimates are given.

36399 (CONF-800491—, pp 146-149) **SPS and alternative technologies cost and performance evaluations.** Samsa, M.E. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

An important consideration in the analysis of the Satellite Power System (SPS) concept for electrical energy production early in the twenty-first century is its expected generation cost in comparison with that for alternative technologies. This study uses, as a standard metric, the constant dollar levelized annual revenue requirement for production of a unit kilowatt-hour of electrical energy from each system as the basis for comparison. Levelized annual revenue requirement, expressed in mills/kWh, is essentially a discount factor weighted average unit cost of energy production which includes all components of capital recovery, fuel, and nonfuel operating cost projected over the facility's economic lifetime. A typical utility's weighted average cost of capital, exclusive of general inflation, was selected as the appropriate discount rate. Results are reported.

36400 (CONF-800491—, pp 164-167) **SPS structures and control: a perspective.** Ried, R.C. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Current concepts for a Solar Power Satellite (SPS) call for inherently large systems. In the relatively benign external load environment of space, however, the characteristics and design requirements for the structure and control systems are quite different from a terrestrial system. To provide a perspective on these systems, and to provide some background for the more comprehensive papers which follow, a rather simplistic but indicative analysis on a representative configuration has been developed. This approach addresses a particular concept only as a mechanism for providing insight.

36401 (CONF-800491—, pp 168-171) **SPS attitude control and stationkeeping: requirements and tradeoffs.** Oglevie, R.E. (Rockwell International, Downey, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The results of attitude control and stationkeeping (AC & SK) studies to define spacecraft and mission requirements, preferred control approaches, and feasibility issues are summarized. The work was partially accomplished under NASA MSFC Contract NAS8-32475. The large size of the SPS makes appreciable changes in AC & SK requirements relative to small contemporary spacecraft. Analyses indicate that the solar pressure stationkeeping perturbation becomes dominant rather than the solar-lunar gravitational perturbation. Gravity gradient disturbance torques increase rapidly as a function of spacecraft size and can cause appreciable attitude control penalties without judicious choice of spacecraft reference orientation and spacecraft design parameters. Structural bending frequencies are appreciably reduced, raising concern about control system/structural dynamic interaction stability.

36402 (CONF-800491—, pp 172-175) **Satellite power systems structures: a 1980 technology status review.** Greenberg, H.S. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

In 1976, the Department of Energy and NASA initiated a broad concept evaluation program to develop, by 1980, an initial understanding of the economic practicality and socio/environmental acceptability of the Satellite Power System (SPS) program. An essential component of the program is the system definition studies, within which are the structure technology investigations. The current SPS structure technology status is reviewed. System definition studies for JSC (Boeing) and MSFC (Rockwell) are being focused on three configurations. Two configurations capture sunlight on ultra-large arrays of either silicon or gallium arsenide solar cells and transmit the generated electrical energy through conductor runs and rotary joint to the microwave power transmission system (MPTS) composed of either solid-state power amplifiers or klystron tube devices. The solid-state configuration delivers sunlight through primary and secondary reflectors (CR = 5) to solar cells that are structurally integral with the solid-state amplifiers and, hence, eliminate electrical conductors and power transfer across a rotary joint. The classes of major structural components and constructions utilized by these configurations are delineated along with designation of the general status of the technology.

36403 (CONF-800491—, pp 180-183) **Modern control approach to the design of the SPS control system.** Gran, R. (Grumman Aerospace Corp., Bethpage, NY). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The structural dynamics of the solar power satellite are complex. There are many low frequency vibration modes with frequencies that are closely clustered. In addition, the requirements on the vibration of the microwave antenna are very severe. Lastly, the possibility of thermal induced vibration is such that severe structural-thermal interactions are possible. There are several distinct avenues that one may follow if the control system is designed using modern control methods. These are: (1) design of an optimal controller with an estimator (Kalman Filter) to reconstruct the missing measurements of the structural motion; (2) design of a control system that uses only measurements, that is with no estimation of the missing dynamic states; this is sometimes called direct output feedback; and (3) design of a control system on a very limited set of models and then adaptively modify the control system during its operation. These techniques are briefly discussed. (WHK)

36404 (CONF-800491—, pp 185-188) **Design of low-cost structures for extensive ground arrays.** Franklin, H.A.; Leonard, R.S. (Bechtel National, Inc., San Francisco, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

There is a great deal of similarity between the functional requirements for support structures for flat plate photovoltaic arrays and for the Satellite Power System (SPS) rectenna panels. Much work relevant to the SPS rectenna design effort has been done on developing design criteria and structural designs for low-cost support structures for terrestrial photovoltaic power plants. The work done by Bechtel National, Inc. for Sandia Laboratories to develop conceptual designs of solar array support structures and their foundations including considerations of the use of concrete, steel, aluminum, or timber is reported. Some cost trends were examined by varying selected parameters to determine optimum configurations. Detailed civil/structural design criteria were developed during this work. Using these criteria, eight detailed designs for support structures and foundations were developed and cost estimates were made. Cost estimates for array supports and foundations were shown to vary between $2 to $3 per square foot of supported panels (deflated to 1975 dollars).

36405 (CONF-800491—, pp 189-192) **SPS structural dynamics and control workshop: findings and recommendations.** Ried, R.C. (Johnson Space Center, Houston, TX); Mingori, D.L. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Recently a technical workshop was held at the Johnson Space Center to examine issues related to the structural dynamics and control of the Solar Power Satellite (SPS). The panel members represent some of the nation's leading experts in controls, structural dynamics, structures and materials. The objectives of the workshop were for this panel to: (1) assess and critique the assumptions, methodologies and conclusions of existing SPS studies in the areas of structural dynamics and control (with structural design and materials also being considered) and (2) identify critical issues in these ares and make recommendations for future work. Within the time and resources available it was not possible to provide the panel with a comprehensive review of the overll SPS system characteristics or to penetrate into the intersystem design issues and tradeoffs. In fact the workshop was only able to highlight the activities in structures, control and materials. In spite of these limitations the panel has afforded an excellent review and developed a valid perception as to the status of the SPS work in their areas of expertise. Preliminary inputs from the panel members are briefly discussed.

36406 (CONF-800491—, pp 216-218) **Technology alternatives for the SPS.** Glaser, P.E.; Chapman, P.K. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The NASA/DOE reference design adopted for the SPS is based on current technology, with realistic projections for improvements in areas such as the cost and specific mass of photovoltaic cells. It provides a common benchmark for use in assessments of the implications of the SPS in societal, economic, industrial, military, environmental and other areas. However, it is recognized that new technologies are emerging which may offer advantages over those selected for the reference system. It is important to maintain a continuing evaluation of the technological alternatives, so as to exhibit potential improvements in the SPS, permit estimates of the technical and cost risk involved, and develop guidelines for future research. Some of these technological alternatives are discussed.

36407 (CONF-800491—, pp 219-222) **Prototype solar power satellite options.** Sperber, B.R.; Drexler, K.E. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

An optimal path cost minimization problem is presented every time a new system is implemented. A system like the solar power satellite (SPS) is a special challenge because the anticipated development costs are large and, due to optics, the microwave power transmission link can not economically be scaled down to powers of less than a gigawatt. This paper addresses the choice of options for the prototype SPS, which is currently the least well defined of the three major items in the SPS development program. (The other two major items are the construction base and the heavy lift launch vehicle.)

36408 (CONF-800491—, pp 231-233) **Passive solar reflector satellite revisited.** Polk, C.; Daly, J.C. (Univ. of Rhode Island, Kingston). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Principal disadvantages of the solar power satellite, as normally proposed, are its cost and low overall efficiency (about 7 percent). To overcome conversion losses and to avoid the need for photo-voltaic cells, an alternative system has been proposed: passive light-weight reflectors in space which direct the incident solar energy to a specified location on the surface of the earth. There either photo-voltaic cells are employed or, after light concentration by another reflector system, a steam turbine alternator on a solar tower, or a similar conventional, relatively high efficiency cycle is used for electricity generation. This idea has been discarded in the past, because the small, but nevertheless significant divergence of rays at the earth-solar distance due to the finite diameter of the sun would produce a minimum spot diameter of 330 km on the earth's surface if a single passive reflector or lens is used in geostationary orbit. Optical calculations for single lens and two lens systems are given, and reflector sizes calculated. (WHK)

36409 (CONF-800491—, pp 234-236) **Comparison of low earth orbit and geosynchronous earth orbit.** Drummond, J.E. (Power Conversion Tech. Inc., San Diego, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The potential advantages of Solar Power Satellites are attenuated by the costs of transmitting power from geosynchronous orbit to load centers on earth. The capital cost of the transmitting facilities is dependent on the areas of the antenna, A/sub T/, and rectenna, A/sub R/. These two areas are connected together by the requirement of high efficiency power transmission: A/sub T/ A/sub R/ ≈ 3 lambda^{2}R^2/cos(θ) where lambda = 0.12 m is the wavelength of the power radiation, R is the distance between antenna and rectenna, and θ is the angle between the beam and local zenith at the rectenna. The area A/sub R/ used here does not include the public safety exclusion area which will have to be many times larger. In an attempt to greatly reduce this initial cost, proposals have been made to decrease R by a factor of ~ 5. According to the equation this would allow both A/sub T/ and A/sub R/ to be greatly reduced. Since the power transmission subsystem represents about half the capital cost of the total SPS reference system, it is worthwhile to consider the low orbit alternative at an early stage so that its technological, environmental, social and political problems and advantages may be assessed in comparison with those of the geosynchronous forms. The salient features of a low orbit system are pointed out.

36410 (CONF-800491—, pp 240-242) **Satellite power system total proof-of-concept program.** McRae, W.V. Jr. (Rockwell International, Huntsville, AL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36411 (CONF-800491—, pp 243-245) **Power conversion perspective.** Brantley, L.W. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36412 (CONF-800491—, pp 246-249) **Gallium arsenide (GaAs) power conversion concept.** Nussberger, A.A. (Rockwell International, Downey, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Rockwell Satellite Power System concept which utilizes gallium arsenide (GaAs) solar cells and flat plate concentrators (CR = 2) to generate 9.52 GW of power at the array sufficient for the satellite microwave antenna system to deliver 5 GW at the utility interface is described. The solar array bay configuration and design factors are discussed. One concept uses a 3-bay by 10-bay matrix 3,900 m wide by 16,000 m long exclusive of the antenna. Each bay contains two panels 600 m by 750 m, providing a voltage string of 45.7 kV. The 600-m width consists of 24 rolls each 25-m wide.

36413 (CONF-800491—, pp 250-253) **SPS silicon reference system.** Woodcock, G.R. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The silicon reference SPS is one of two reference designs developed by the NASA Systems Definition Studies, the other being

a Gallium Arsenide option. The main features of the silicon reference system are described. The solar array consists of glass-encapsulated 50-micrometer silicon solar cells, interconnected in series-parallel arrangement to provide the necessary voltage and cell failure redundancy. The array blankets are suspended in a space-frame cubic trusswork of 128 bays, each 667.5 meters square and 470 meters deep. A tension catenary system maintains the solar cell blanket in each bay adequately flat, with a trampoline natural frequency about twice that of the solar array support structure as a whole. The array area of 49.6 square kilometers generates 8766 megawatts (dc) electric power at 44 kV. This electric power is conducted by an arrangement of ten pairs of power busses to the electrical slip ring interface between the power transmitter. The transmitter converts the electric power to 6700 megawatts of radiated rf power at 2450 megahertz. (WHK)

36414 (CONF-800491—, pp 254-257) **Proton damage annealing kinetics in silicon solar cells.** Horne, W.E.; Arimura, I.; Day, A.C. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Proton damage annealing has been postulated as a method for prolonging the life of solar power systems in space. This paper describes a study of such damage annealing. The objectives of the study were to (1) minimize variables and examine fundamental characteristics of proton damage annealing, (2) to make preliminary evaluation of the usefulness of annealing for prolonging space missions, (3) to make a preliminary determination of optimum annealing conditions, and (4) to provide a data base for planning more detailed research programs. A preliminary analytical model to describe the annealing of proton damage as a function of time and temperature in silicon solar cells is discussed. The analytical work is supported by data from detailed isochronal and isothermal annealing experiments on 2-Ω-cm N/P silicon solar cells after irradiation to various fluences of 1.5 MeV protons. (WHK)

36415 (CONF-800491—, pp 263-266) **Evaluation of solar cell materials for a solar power satellite.** Glaser, P.E.; Almgren, D.W.; Csigi, K.I. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Silicon is presently the only photovoltaic material that is being considered for mass production as part of the US Department of Energy (DOE) Photovoltaic Program. Single-crystal silicon solar cells could meet the projected needs of the ground-based exploratory development and space technology verification during the period 1980 to 1985, and is the most likely photovoltaic material for use in SPS pilot and prototype systems. Gallium arsenide is a promising photovoltaic material, however, gallium arsenide solar cells in suitable form, sufficient quantity, having reproducible characteristics and an acceptable cost are unlikely to be available before 1985 unless there is a near-term significant R & D program commitment. Furthermore, other advanced photovoltaic materials, e.g., amorphous silicon, are being investigated as part of the DOE Photovoltaic Program which may deserve consideration as candidates for SPS solar cell arrays if they could be mass produced at low cost.

36416 (CONF-800491—, pp 267-270) **Solar driven lasers for power satellite applications.** Taussig, R.; Cassady, P.; Klosterman, E. (MSNW, Bellevue, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Multi-megawatt lasers appear to be technologically feasible for space power transmission in the 1990s time frame. Solar driven lasers based on conventional gas dynamic and electric discharge laser concepts (GDLs and EDLs) have been investigated to determine the feasibility of using existing laser technology for this application. With conventional solar photocells as the power source the GDL and EDL lasers do not appear to be as efficient as microwaves in transmitting power back to earth. However, for relatively new and untested laser concepts such as the solar optically pumped laser (OPL) and free electron laser (FEL) much higher laser efficiencies may be achievable, leading to a laser SPS system competitive with the microwave SPS. Because of their compact transmitters and receivers, lasers may have an advantage in better economies of scale for smaller SPS sizes than the microwave SPS. Further, laser light wavelengths longer than 2.5 microns may be considerably safer and have less impact on the earth's environment (e.g., communications) than microwaves. For these reasons one should consider the laser as a serious power transmission option. Results from a brief survey of solar powered, space-based lasers are given to gain some perspective on the types of lasers reasonable for power transmission. A preliminary selection of candidate lasers for SPS application was made on the basis of scalability to high powers (1 MW and greater), relative weights, efficiency (better than 1%), and safety (wavelengths greater than 2.5μ). The preliminary list includes CO and CO_2 EDLs, direct optically pumped lasers (e.g., CF_3I, etc.), indirect optically pumped lasers (e.g., CO/CO_2 mixing laser), and free electron lasers (FELS).

36417 (CONF-800491—, pp 271-272) **Conclusions of the Huntsville SPS power conversion workshop.** Williams, J.R. (Georgia Inst. of Tech., Atlanta). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The National Aeronautics and Space Administration sponsored a workshop on SPS Energy Conversion and Power Managemnt February 5 to 7, 1980. The workshop was hosted by the Johnson Environmental and Energy Center of the University of Alabama in Huntsville. The three topics under consideration were SPS Photovoltaic Power Systems, SPS Solar Thermal Power Systems, and Power Distribution and Management. Some of the conclusions and recommendations are briefly discussed. (WHK)

36418 (CONF-800491—, pp 273-276) **Power transmission and reception: an overview and perspective.** Dietz, R.H. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

As part of the DOE/NASA Concept Development and Evaluation Program, NASA has been actively involved in conducting the SPS systems definition effort as well as undertaking certain critical technology supporting investigations. Definition and assessment of the Power Transmission and Reception System has been an important part of that activity. Investigations into concepts for power transmission and reception have primarily concentrated on microwaves as a transport means, although preliminary laser concepts have recently begun to be analyzed. The Microwave Power Transmission and Reception (PTAR) System activities are briefly described. (WHK)

36419 (CONF-800491—, pp 281-284) **Satellite power system concept development and evaluation program: critical supporting investigations. Summary.** Seyl, J.W. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36420 (CONF-800491—, pp 297-300) **Smaller SPS system sizing tradeoffs.** Arndt, G.D.; Monford, L. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The present solar power satellite (SPS) system was optimized to provide 5 GW of electrical power at the ground using a 1 km diameter antenna and a 10 km diameter rectenna. This antenna sizing and maximum power transmission were determined by two constraints; a 23 kW/m^2 thermal limitation in the transmit antenna and a 23 mW/cm^2 maximum rf power intensity in the ionosphere. This paper considers technical and economic tradeoffs of smaller optimized SPS systems configured with larger antennas, reduced output powers, and smaller rectennas. The advantages of smaller systems are two-fold: (1) commercial utility companies prefer to integrate lower power levels into their grids, and (2) smaller rectenna sizes than the 10 km diameter reference configuration may be preferred from a land utilization and site location viewpoint. The differential costs in electricity for seven antenna/rectenna configurations operating at 2.45 GHz and five satellite systems operating at 5.8 GHz have been determined; the results are summarized.

36421 (CONF-800491—, pp 316-318) **Construction of the SPS primary structure by another method.** Taylor, T.C. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The SPS primary structure contains about 10,000 tons of long fragile structural members. This framework can be built using aluminum foam. Not all members are carrying the same loads, so a method which allows the member to be modified to accommodate various loadings would be cost effective. The aluminum is salvaged from expended external tanks. Each ET contains 63,000 lbs. of aluminum and this material could be the least expensive basic building material we will see in space for many years. The ET reaches 99% of full orbital velocity prior to being jettisoned and forced back into the atmosphere. The ET re-entry location is assured by tumbling the tank to increase its aerodynamic drag on the upper atmosphere. Taking the ET into orbit may increase the performance of the orbiter by eliminating the rollercoaster maneuver performed to force the tank back into the atmosphere. The concept is to melt down the tank using a direct solar smelting device, inject an agent which produces the foamed aluminum and shape it to any section desired.

36422 (CONF-800491—, pp 319-322) **Specific SPS construction studies: operations and maintenance.** Miller, K.H. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The overall scope of the Solar Power Satellite program operations is depicted. These operations involve many surface as well as in space operations. These operations are discussed using the

12th year of commercial operations as a model. During this time period, the primary end products of SPS industrial enterprise are the following: (1) operation and maintenance of 20 satellites, (2) completion of a new SPS and its ground receiving antenna every 6 months, and (3) construction of electric cargo orbital transfer vehicles (EOTV's) at the rate of one vehicle every 45 days.

36423 (CONF-800491—, pp 324-326) **Automated construction of lightweight, simple, field-erected structures.** Leonard, R.S. (Bechtel National, Inc., San Francisco, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Power plants requiring less labor per kilowatt to build will be cheaper, less affected by inflation, and not as constrained by labor shortages. Recent advances in such diverse fields as industrial automation and autonomous planetary rovers indicate that a synthesis of these advanced techniques could result in mobile construction robots. These robots would perform a limited number of very repetitive tasks at relatively benign construction sites. The example demonstrating the feasibility of this proposal is the construction of a large photovoltaic power plant having a peak power output of 100 megawatts. This is similar to the support structures proposed for the Satellite Power System (SPS) rectenna. Preliminary cost estimates show that a limited labor force using construction robots could reduce direct labor costs between 23 to 79 percent. The approach taken is: to present the reasons to automate the construction process; to define the conventional construction scenario as the reference for evaluation; to list the potential cost benefits by using robots; to demonstrate the technical feasibility of building several possible construction robots; and to show the application to build SPS ground stations. The conclusions given would also apply to underground and surface mining operations, mechanized agriculture, and other industrial situations.

36424 (CONF-800491—, pp 340-343) **Solid-state configurations.** Schroeder, K.G. (Rockwell International, Anaheim, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Two prototype solid-state phased array systems concepts developed by Rockwell for the Solar Power Satellite (SPS) are described. In both concepts, the beam is centered on the rectenna by means of phase conjugation of a pilot signal emanating from the ground. Also discussed are solid-state studies performed at Boeing and Raytheon.

36425 (CONF-800491—, pp 344) **Solid state technology.** Weir, D.G. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36426 (CONF-800491—, pp 345-347) **Microwave power transmission workshop summary.** Freeman, J.W. (Rice Univ., Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Satellite Power System (SPS) Workshop on the Microwave Power Transmission System (MPTS) was held at the Johnson Space Center in Houston, Texas on January 15 to 18, 1980. The objectives of this workshop were to assess and critique the assumptions, methodologies and conclusions of the NASA SPS studies and to identify and assess critical issues and to make recommendations for follow-on work. The review panel assessment is summarized.

36427 (CONF-800491—, pp 372-375) **High voltage space plasma interactions.** McCoy, J.E. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

All large space structures in Earth orbit are immersed in a very tenuous ionized gas. This ionized gas (called plasma) exists everywhere in space. Although so tenuous as to be completely insignificant for most purposes to date, this plasma provides a source of electric current carriers which can become very significant for large structures and/or high voltages. Adequate consideration of such effects should be included during design of the SPS. There have been two primary problems identified to result from plasma interactions; one of concern to operations in geosynchronous orbit (GEO), the other in low orbits (LEO). Spacecraft charging has become widely recognized as a problem, particularly for communications satellites operating in GEO. The very thin (0.1 to 10/cc) thermal plasmas at GEO are insufficient to bleed off voltage buildups (>10 kv) due to higher energy charged particle radiation collected on outer surfaces. Resulting differential charging/discharging causes electrical transients, spurious command signals and possible direct overload damage. Ionospheric plasma densities exceeding one million/cc exist around spacecraft in LEO. Operation of large solar arrays at high voltage, for SPS developmental testing or LEO assembly/self-propulsion, could drive substantial leakage currents through this surrounding plasma. The resulting power loss to these parasitic currents has been observed to exceed solar cell output capacity for small (10 cm) test objects in the laboratory. (WHK)

36428 (CONF-800491—, pp 377) **SPS power management workshop summary.** Williams, J.R. (Georgia Inst. of Tech., Atlanta). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36429 (CONF-800491—, pp 414-418) **Summary of the electromagnetic compatibility evaluation of the proposed satellite power system.** Morrison, E.L. Jr. (Inst. for Telecommunication Sciences, Boulder, CO); Grant, W.B.; Davis, K.C. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The EMC Evaluation program concerns the effects of the proposed SPS operations on electronic equipment and systems by fundamental, harmonic, and intermodulation component emissions from the orbital station; and the fundamental, harmonic, and structural intermodulation emissions from the rectenna site. With each satellite transmitting a power of 6.85 GW, and the reference design including 60 satellite-rectenna systems, the coupling and affects interactions encompass a wide spectrum of electronic equipments. The primary EMC tasking areas are briefly described.

36430 (CONF-800491—, pp 419-422) **Effects of a satellite power system on ground-based astronomy.** Thompson, A.R. (National Radio Astronomy Observatory, Socorro, NM). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36431 (CONF-800491—, pp 423) **SPS effects on optical astronomy.** Schuster, G.J. (Pacific Northwest Lab., Richland, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36432 (CONF-800491—, pp 424-427) **EMC of satellite power systems and DoD C-E systems.** Atkinson, J.H. (DoD ECAC, Annapolis, MD); Aasen, M.D. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Department of Defense (DoD) is vitally interested in the satellite power system (SPS) concepts presently being proposed, since electromagnetic spectrum sharing would be required with many military C-E systems. The objective of this discussion is to present the DoD Electromagnetic Compatibility Analysis Center's (ECAC) technical understanding of the SPS and to assess the potential electromagnetic impact on existing DoD operations in the southwestern portion of CONUS. This geographical area is of principle concern because of the likelihood of SPS earth rectenna locations.

36433 (CONF-800491—, pp 428-430) **Encounters between SPS power beams and satellites in lower orbits.** Chapman, P.K. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Each Solar Power Satellite (SPS) will preempt, not only a location in geosynchronous orbit (GEO), but a large region of space (of order several hundred thousand cubic kilometers) for its power beam. If the SPS is geostationary, the beam is fixed relative to the Earth and thus rotates like the spoke of a wheel with the diurnal rotation. Other satellites in lower orbits (including those in transit to GEO) may pass through the beam, causing RFI with satellite systems or perhaps damage to sensors. In some cases, it may be necessary briefly to shut down a given SPS as a satellite approaches its power beam. The problem is discussed.

36434 (CONF-800491—, pp 431-434) **EMC impact of SPS operations on low earth orbit satellites.** Grant, W.B. (Inst. for Telecommunications Sciences, Boulder, CO); Morrison, E.L. Jr.; Davis, K.C. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Low orbiting (LEO) satellites have a significant probability of passing through an SPS main beam or principal sidelobes. This probability, and consequently the frequency of traversal, depends on the number of SPS stations in operation. Operational effects for LEO satellites depend on orbits, equipment complement and usage modes, and vehicle physical configuration. Existing and planned LEO systems include remote sensing, navigation and position fixing, and communications functions. Sensors include electro-optical devices, active and passive microwave systems, and particle detectors. The susceptibility of various operational and planned LEO satellites has been examined during the course of the SPS EMC evaluation program. Functional degradation for the electronic systems on LANDSAT, GPS, and the Space telescope is described in relation to the amplitude of the SPS illumination components. Analyses and

tests include the modes of coupling to devices and subsystems, and performance effects in relation to satellite mission.

36435 (CONF-800491—, pp 435-438) **SPS interference problem: electronic system effects and mitigation techniques.** Juroshek, J.R. (Dept. of Commerce/NTIA, Boulder, CO). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The potential for interference between SPS and various electronic systems is discussed. Some of the causes of interference and their cures are reviewed, and estimates are presented of the various interference levels that can be expected from SPS. Interference problems and protection requirements for satellite systems and interference problems to other electronic devices such as integrated circuits are considered.

36436 (CONF-800491—, pp 529-530) **Potential for reception of SPS microwave energy at offshore rectennas in Western Europe.** Collins, P.Q. (Imperial College of Science and Technology, London, England). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

For the present study a deliberately simple design, based on tried technology, was considered. The rectenna elements and structure are supported on light piles or floats, and completely surrounded by a protective sea wall. The cost of the sea wall depends on the depth of the water, and so site evaluation was restricted initially to areas with water depths of less than 25 metres, between 10 and 50 km offshore. Some twenty such areas of suitable size were identified around the Northern coast of WE, comprising some 20,000 square kilometres in total. The major factors relating to the offshore sites considered relevant to siting are outlined.

36437 (CONF-800491—, pp 531-533) **Preliminary SPS materials assessment.** Teeter, R.R.; Jamieson, W.M. (Battelle Columbus Labs., OH). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Presently, there are two SPS reference design concepts (one using silicon solar cells; the other using gallium arsenide solar cells). A materials assessment of both systems was performed based on the materials lists set forth in the DOE/NASA SPS Reference System Report: Satellite Power System Concept Development and Evaluation Program October, 1978. This listing identified 22 materials (plus miscellaneous and organics) used in the SPS. Tracing the production processes for these 22 materials, a total demand for over 50 different bulk materials (copper, silicon, sulfuric acid, etc.) and nearly 20 raw materials (copper ore, sand, sulfur ore, etc.) was revealed. Potential materials supply problems are summarized.

36438 (CONF-800491—, pp 564-567) **Different race.** Leonard, R.S. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The proposal to build a space industrial complex, produce Satellite Power Systems, and implement a Hydrogen Fuel Economy is discussed and declared to be technically feasible, economicaly competitive with other alternatives, and environmentally acceptable. In addition, the effort is worthwhile from the standpoint of maintaining a belief that this nation is committed to moving forward and providing the resources needed for its population to realize its aspirations.

36439 (CONF-800491—, pp 576-578) **Industrial infrastructure for the solar power satellite.** Glaser, P.E.; Chapman, P.K. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

An assessment of the impact on the industrial infrastructure of key subsystems of the SPS reference system was performed by comparing the SPS production requirements with the present and projected capabilities of US industry in applicable industry sectors. Analysis of the timing of production plant capacity additions and associate capital investment indicated that there is considerable latitude either to delay a plant start-up date to complete development of promising technologies, or to start the production earlier to reduce the impact on an industry sector without a serious cost penalty. The results of the assessment of the impacts on the industrial infrastructure for the photovoltaic subsystems, ion engines, dipole rectifiers, microwave generators, and graphite fiber reinforced composite structures are summarized. (WHK)

36440 (CONF-800491—, pp 579-580) **Utility system impacts of the satellite power system.** Goodman, F.R. Jr. (Electric Power Research Inst., Palo Alto, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The technical requirements and barriers for integration of the satellite power system into an electric utility network are briefly discussed. Outage during eclipse periods, system stability, load following, reliability, and maintenance scheduling are mentioned. (WHK)

36441 (CONF-800491—, pp 583-586) **Assessment of SPS utility integration issues arising from the distribution of eligible rectenna sites and electricity demand centers.** Hill, J.A.; Rabe, J.A. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

This study identifies institutional, regulatory and technical utility integration issues involving the distribution of eligible rectenna sites and electricity demand centers throughout the continental United States. The report assesses both the integration issues/problems associated with siting a network of 60 SPS rectennas in the continental US, and the extent to which these problems are mitigated and/or exacerbated by the nominal SPS rectenna distribution pattern developed in the course of this study.

36442 (CONF-800491—, pp 587-588) **Electric utility requirements affecting solar power satellite development and deployment.** Kubitz, K.R.; Moss, R.H. (Pacific Gas and Electric Co., San Francisco, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36443 (CONF-800491—, pp 598-599) **SPS salvage and disposal alternatives.** Hazelrigg, G.A. Jr. (ECON, Inc., Princeton, NJ). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The satellite portion of the Satellite Power System (SPS) has a currently estimated lifetime of 30 years. The capital costs of the satellite less its net salvage value (gross salvage value less removal cost) must be amortized over that lifetime. To date, however, system cost and trade studies have been based on the assumption that the SPS satellite has zero net value at the end of that time. Many factors make this assumption inappropriate: many SPS components are replaced periodically and thus will be relatively new at the end of the 30-year satellite life; some SPS components will have lifetimes well in excess of 30 years; the SPS satellite may still be capable of producing substantial amounts of power, even in various states of degradation, that could prove useful to non-terrestrial applications; the SPS satellite represents a fairly large deposit of materials conveniently located in geosynchronous orbit; the SPS satellite represents a fairly sizeable source of refined materials that might be economically returned to earth for reuse. Possibilities are briefly discussed.

36444 (CONF-800491—, pp 600-602) **Satellite power station and non-cost uncertainty aspects of risk.** Hopkins, M.M. (The Rand Corp., Santa Monica, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36445 (CONF-800491—, pp 603-606) **SPS: their financing and macroeconomic effects.** Block, R.S. (Univ. of Pennsylvania, Philadelphia). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36446 (CONF-800491—, pp 618-621) **Satellite power system cost review.** Allen, R.E.; Brown, P.E.; Ziegler, E.J. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36447 (CONF-800491—, pp 625-626) **Utilities view of SPS.** Patmore, J.; Bohn, J. (Systems Control, Inc., Palo Alto, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36448 (CONF-800491—, pp 627-630) **Alternative advanced power generation technology characterizations.** Samsa, M.E. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Seven alternative technologies that have been selected for comparison with the SPS include the following: (1) conventional coal combustion with Wellman-Lord flue gas desulfurization; (2) light water reactor with improved fuel utilization; (3) gas turbine combined cycle with integral low Btu gasifier; (4) Liquid Metal Fast Breeder Reactor; (5) central station photovoltaic without storage; (6) residential rooftop photovoltaic with advanced lead-acid battery storage; and (7) magnetic confinement fusion. Major characteristics are tabulated for comparison. (WHK)

36449 (COO—4094-81) **Lightning strike at Bryan, Ohio.** Nichols, B.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Feb 1980. Contract AC02-76ET20279. 19p. NTIS, PC A02/MF A01.

A week before the 29 August 1979 dedication of the photovoltaic power system at daytime AM radio station WBNO, in Bryan,

Ohio, a lightning superbolt struck the FM radio tower, one of two towers at the station. Minor damage to the station and to components of the photovoltaic system, the latter designed by MIT Lincoln Laboratory under US Department of Energy sponsorship, is described. This rare strike suggested the need for increased protection and more voltage-transient suppressors were added to those already in place as a preventive measure in the event that such a phenomenon reoccurs.

36450 (DOE/CS/32522—T1) **Solar photovoltaic applications seminar: design, installation and operation of small, stand-alone photovoltaic power systems.** (PRC Energy Analysis Co., McLean, VA (USA)). Jul 1980. Contract AC01-77CS32522. 351p. NTIS, PC A15/MF A01.

This seminar material was developed primarily to provide solar photovoltaic (PV) applied engineering technology to the Federal community. An introduction to photoconductivity, semiconductors, and solar photovoltaic cells is included along with a demonstration of specific applications and application identification. The seminar details general systems design and incorporates most known information from industry, academia, and Government concerning small solar cell power system design engineering, presented in a practical and applied manner. Solar PV power system applications involve classical direct electrical energy conversion and electric power system analysis and synthesis. Presentations and examples involve a variety of disciplines including structural analysis, electric power and load analysis, reliability, sizing and optimization; and, installation, operation and maintenance. Four specific system designs are demonstrated: water pumping, domestic uses, navigational and aircraft aids, and telecommunications. All of the applications discussed are for small power requirement (under 2 kilowatts), standalone systems to be used in remote locations. Also presented are practical lessons gained from currently installed and operating systems, problems at sites and their resolution, a logical progression through each major phase of system acquisition, as well as thorough design reviews for each application.

36451 (DOE/PE—03871-01, pp 2.1-2.21) **Photovoltaic systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

A review of the design, operation, economics, power conditioning circuits, and performance of photovoltaic power supplies is presented. A technology summary sheet is included.

36452 (SAND—79-7057) **Wind design of flat panel photovoltaic array structures. Final report.** (Bechtel National, Inc., San Francisco, CA (USA). Research and Engineering Div.). Jun 1980. Contract AC04-76DP00789. 174p. NTIS, PC A08/MF A01.

Bechtel National, Inc., has conducted a study of feasible low-cost structures for solar photovoltaic central power plants. Wind load magnitudes for these arrays significantly influence structural costs. Wind load prediction is hampered by the lack of specific information for these unique structures. Accordingly, a wind-tunnel test program was completed at the Fluid Dynamics Laboratory of Colorado State University, Fort Collins, Colorado. This testing gave wind force coefficients for single or large-field photovoltaic arrays and the resulting design criteria are reported. The test program was a limited effort to advance the state of the art and further work is recommended.

SOLAR THERMAL POWER SYSTEMS

REFER ALSO TO CITATION(S) 36232, 36235, 36236, 36237, 36238, 36239, 36240, 36241, 36242, 36243, 36244, 36245, 36246, 36247, 36248, 36249, 36250, 36251, 36252, 36253, 36254, 36255, 36256, 36257, 36258, 36259, 36260, 36261, 36263, 36264, 36265, 36266, 36267, 36268, 36269, 36270, 36271, 36272, 36273, 36274, 36275, 36277, 36278, 36279, 36280, 36281, 36282, 36283, 36284, 36285, 36286, 36288, 36383, 36384, 36385, 36386, 36387, 36388, 36389, 36390, 36392, 36393, 36394, 36395, 36396, 36397, 36399, 36400, 36401, 36403, 36405, 36406, 36408, 36409, 36410, 36411, 36417, 36418, 36419, 36420, 36421, 36422, 36425, 36426, 36427, 36428, 36429, 36430, 36431, 36432, 36433, 36434, 36435, 36436, 36438, 36440, 36441, 36442, 36443, 36444, 36445, 36447, 36623, 36624, 36625, 36626, 36627, 36628, 36629, 36630, 36631, 36632, 36633, 36634, 36636, 36740, 36741, 36780, 37243, 37244, 37245, 37246, 37248, 37274, 37275, 37276

36453 (CONF-800491—, pp 237-239) **Infrared alternative.** Andlauer, G. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A satellite structure is proposed that absorbs the solar radiation and reemits it to the interior of the structure as far infrared radiation. The infrared is directed through a screen of filtering panels that filter out the wavelengths that will be absorbed by the earth's atmosphere. The emergent beam which consists of the wavelengths that coincide with the optical apertures of the atmosphere is directed toward the ground receptor structure. (WHK)

36454 (DOE/ET/21038—1(Vol.1)) **Solar central receiver hybrid power system, Phase I. Volume 1. Executive summary. Final technical report, October 1978-August 1979.** (Martin Marietta Corp., Denver, CO (USA)). Sep 1979. Contract ET-78-C-03-2234. 34p. NTIS, PC A03/MF A01.

The Martin Marietta team has conducted system analyses and conceptual designs of hybrid systems employing molten salt (60% $NaNO_3$, 40% KNO_3) heat transfer/storage media using a solar central receiver and a fossil-fired nonsolar energy source (coal, oil or gas). System- and subsystem-level analyses were performed to develop preferred system configurations using various amounts of solar storage capacities and fossil fuels. The various systems in this report are based on a technical approach that promotes higher conversion efficiencies, greater operational flexibility, and lower net energy costs than first generation water/steam receiver technology. In fact, the analysis shows that in the 1990 time frame, hybrid and solar standalone power systems based on molten salt technology are competitive with peaking, intermediate and baseload conventional power technology. The hybrid plant consists of solar and nonsolar portions of the plant that operate in parallel. For the solar portion of the plant, molten salt is heated in cavity receivers and delivered to salt storage tanks. The hot salt is used to generate steam for the turbine in salt heat exchangers. For the nonsolar portion of the plant, molten salt is heated in a fossil-fired salt heater and delivered to the salt storage tanks. The large quantities of storage and associated heliostats result in large plant capacity factors (0.75) from the solar portion of the plant, minimize the busbar energy costs, permit nonsolar subsystems less than the plant rating and minimize the amount of fossil fuel burned. An executive summary of the selection of the preferred system configuration, conceptual design, assessment of the commercial plant, and development plan is presented. (WHK)

36455 (DOE/PE—03871-01, pp 3.1-3.36) **Solar thermal power systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The operation, performance, concentrating collector technology, and economics of solar heat engines/thermal power systems are reviewed. Present and projected costs of a range of solar concentrator options are tabulated. (WHK)

36456 (PNL—4000(Vol.3)) **Assessment of solar options for small power systems applications. Volume III. Analysis of concepts.** Laity, W.W.; Aase, D.T.; Apley, W.J.; Bird, S.P.; Drost, M.K.; Garrett-Price, B.A.; Williams, T.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 136p. NTIS, PC A07/MF A01.

A comparative analysis of solar thermal conversion concepts that are potentially suitable for development as small electric power systems (1 to 10 MWe) is given. Seven generic types of collectors, together with associated subsystems for electric power generation, were considered. The collectors can be classified into three categories: (1) two-axis tracking (with compound-curvature reflecting surfaces; (2) one-axis tracking (with single-curvature reflecting suraces; and (3) nontracking (with low-concentration reflecting surfaces). All seven collectors were analyzed in conceptual system configurations with Rankine-cycle engines. In addition, two of the collectors (the Point Focus Central Receiver and the Point Focus Distributed Receiver) were analyzed with Brayton-cycle engines, and the latter of the two also was analyzed with Stirling-cycle engines. This volume describes the systems analyses performed on all the alternative configurations of the seven generic collector concepts and the results obtained. The SOLSTEP computer code used to determine each configuration's system cost and performance is briefly described. The collector and receiver performance calculations used are also presented. The capital investment and related costs that were obtained from the systems studies are presented, and the levelized energy costs are given as a function of capacity factor obtained from the systems studies. Included also are the values of the other attributes used in the concepts' final ranking. The comments, conclusions, and recommendations developed by the PNL study team during the concept characterization and systems analysis tasks of the study are presented. (WHK)

36457 (PNL—4000(Vol.4)) **Assessment of solar options for small power systems applications. Volume IV. Comparative ranking of concepts.** Currie, J.W.; Jannol, M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 70p. NTIS, PC A04/MF A01.

A comparative analysis of solar thermal conversion concepts that are potentially suitable for development as small electric power systems (1 to 10 MWe) is presented. Cogeneration and total energy systems were beyond the scope of this study. Seven generic type of collectors, together with associated subsystems for electric power generation, were considered. The collectors can be classified into

three categories: (1) two-axis tracking (with compound-curvature reflecting surfaces); (2) one-axis tracking (with single-curvature reflecting surfaces; and (3) nontracking (with low-concentration reflecting surfaces). All seven collectors were analyzed in conceptual system configurations with Rankine-cycle engines. In addition, two of the collectors (the Point Focus Central Receiver and the Point Focus Distributed Receiver) were analyzed with Brayton-cycle engines, and the latter of the two also was analyzed with Stirling-cycle engines. With these engine options, 10 systems were formulated for analysis. This is the fourth volume of a five-volume report on the work performed to analyze the alternative concepts, and the results obtained. Included in this volume are descriptions of the methodology used with, and concept ranks obtained from, potential users and R and D fund allocators.

36458 (PNL—4000(Vol.5)) **Assessment of solar options for small power systems applications. Volume V. SOLSTEP: a computer model for solar plant system simulations.** Bird, S.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01.

The simulation code, SOLSTEP, was developed at the Pacific Northwest Laboratory to facilitate the evaluation of proposed designs for solar thermal power plants. It allows the user to analyze the thermodynamic and economic performance of a conceptual design for several field size-storage capacity configurations. This feature makes it possible to study the levelized energy cost of a proposed concept over a range of plant capacity factors. The thermodynamic performance is analyzed on a time step basis using actual recorded meteorological and insolation data for specific geographic locations. The flexibility of the model enables the user to analyze both central and distributed generation concepts using either thermal or electric storage systems. The thermodynamic and economic analyses view the plant in a macroscopic manner as a combination of component subsystems. In the thermodynamic simulation, concentrator optical performance is modeled as a function of solar position; other aspects of collector performance can optionally be treated as functions of ambient air temperature, wind speed, and component power level. The power conversion model accounts for the effects of ambient air temperature, partial load operation, auxiliary power demands, and plant standby and startup energy requirements. The code was designed in a modular fashion to provide efficient evaluations of the collector system, total plant, and system economics. SOLSTEP has been used to analyze a variety of solar thermal generic concepts involving several collector types and energy conversion and storage subsystems. The code's straightforward models and modular nature facilitated simple and inexpensive parametric studies of solar thermal power plant performance.

36459 **Low temperature fluid energy conversion system .** Pitts, C. US Patent 4,209,982. 1 Jul 1980. Priority date 7 Apr 1977, United Kingdom of Great Britain and Northern Ireland (UK), vpp.

A low temperature fluid energy conversion system comprising a primary circuit including a first and second cylinder for containing a working fluid, a heat exchange means coupled through a working fluid supply means to said first and second cylinder alternately to receive said working fluid from said first and second cylinder to heat said working fluid, a motor means operatively coupled to said heat exchange means to receive said working fluid therefrom to gerneate mechanical energy thereby, and a working fluid return means coupled between said motor means and said first and second cylinders alternately to return said working fluid to said first and second cylinder, a secondary circuit including a liquid expansion agent supply means coupled to said first and second cylinders to supply said liquid expansion agent to said first and second cylinder such that, as said liquid expansion agent it alternately supplied to said first and second cylinder, the heat from said working fluid within said first and second cylinder vaporizes said liquid expansion agent forcing said working fluid from said first and second cylinder to said heat exchange means, a vapor expansion agent return means coupled between said first and second cylinders and said liquid expansion agent supply means alternately to return said vapor expansion agent to said liquid expansion agent supply means.

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 36290

36460 (DOE/SF/10534—1) **Alternate central receiver power system. Phase II. Midterm topical report.** (Martin Marietta Aerospace, Denver, CO (USA)). Mar 1980. Contract AC03-79SF10534. 327p. NTIS, PC A15/MF A01.

The objective of the Phase II program is to prove the feasibility of the molten salt central receiver power system by conducting a series of experiments and using results to update the commercial system developed during Phase I. The experiments are (1) Receiver Subsystem Research Experiment (SRE), (2) long-term molten salt flow loop, and (3) materials test program. The primary objectives of the receiver SRE are: (1) to demonstrate the safe, reliable, and efficient operation of a solar receiver using molten salt (60% $NaNO_3$, 40% KNO_3) as the heat transfer fluid under operating conditions that simulate a commercial receiver, including fluid temperatures, heat flux, realistic transients (start-up, shutdown, and cloud interruption), and steady-state operation; and (2) to demonstrate the fabrication processes and quality control techniques required for a commercial receiver. The primary objectives of the molten salt loop are: (1) to determine if there is any significant mass transport of material that could effect the life of a molten salt system; (2) to determiae if corrosion rates in a flowing system differ significantly from those in static tests; (3) to establish the chemical stability of molten salt in a system with flow and temperature excursions; and (4) to gain more experience in the design, construction and operation of molten salt systems. The primary objective of the materials test program is to provide materials test data needed to commercialize a solar power plant using molten salt.

36461 (DOE/SF/10535—1/1) **Alternate central receiver power system program. Phase II. Volume I. Commercial plant design refinement. Midterm technical report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. Contract AC03-79SF10535. 220p. NTIS, PC A10/MF A01.

Results of a study to refine the Phase I conceptual design of a 100 MWe sodium cooled central receiver power plant to incorporate improvements in performance and cost are presented in detail. Topics include a solar receiver panel configuration analysis, receiver flow control system cost reduction, storage subsystem design improvements, operating mode analysis, system annual performance analysis, refined conceptual design, and refined plant cost estimate. Appendices include (a) receiver loss analysis code (PANELGR2), (b) PANELGR2 output for selected grouping scheme, (c) component cooldown analysis (initial uniform temperature), (d) component cooldown analysis (initial nonuniform temperature), (e) temperature cycling considerations in the downcomer pipe, (f) trickle flow scheme for short term standby, and (g) computer program listing for system annual performance analysis. (WHK)

36462 (DOE/SF/10535—1/2) **Alternate central receiver power system program. Phase II. Volume II. Sodium test receiver experiment. Midtern technical report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. Contract AC03-79SF10535. 304p. NTIS, PC A14/MF A01.

Progress on the design of a commercial scale (100 MWe) sodium cooled central receiver power plant is reported. This volume of the Phase II report describes the design status, analysis results, and fabrication status of the 2.5 MWth Sodium Receiver Test Assembly (SRTA). The absorber test panel design and fabrication, the sodium loop design and fabrication, the preliminary test plan, and the preliminary safety evaluation are described in detail. (WHK)

36463 (DOE/SF/10535—1/3) **Alternate central receiver power system program. Phase II.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. Contract AC03-79SF10535. 101p. NTIS, PC A06/MF A01.

Progress on the design of a 100 MWe sodium-cooled central receiver power plant is reported. This volume describes the materials experiments. The development project was performed to provide a technique/procedure for the furnace brazing of thin walled tubular Incoloy 800 absorber panels for sodium cooled solar central receiver plants, with an immediate objective of providing a tecnique for the brazing/fabrication of a test panel scheduled for solar testing at the Central Receiver Test Facility in Albuquerque, N.M. in late 1980 and early 1981. This development included selection of a brazing filler metal type, form and application procedure; determination of a joint design that would result in good brazability and mechanical properties; and the selection of an appropriate panel brazing procedure, atmosphere control, orientation and fixturing method in a brazing furnace. Over 100 test specimens were fabricated and brazed. The results of this work were demonstrated by the successful brazing of 122 cm (4 foot long), ten tube wide absorber panel segments. Procedures and results are detailed. (WHK)

OCEAN THERMAL GRADIENT AND SALINITY GRADIENT POWER SYSTEMS

36464 (CONF-800491—, pp 176-179) **Dynamics and control of the Satellite Power System.** Wang, S.J.; Juang, J.N.; Rodriguez, G. (California Inst. of Tech., Pasadena). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The SPS is the largest space system conceived to date that appears feasible with reasonable extensions of existing control technology. It represents a class of large platform-like structures that are several orders of magnitude larger than any of the other large space systems (multiple-payload platforms, parabolic reflectors, etc.) currently in planning within NASA. The SPS has in common with all

large space systems many control problems that are widely recognized within the controls community. These problems include attitude errors due to disturbances, potential instabilities due to truncated modes and other model errors, lack of damping, and inaccurate preflight knowledge of the vehicle dynamics. The qualitative nature of these problems (model errors, concentrated stresses due to large actuator size, etc.) has emerged as a result of studies in the general area of control of large space structures. However, there is a need at this time, to investigate the dynamics and control problems specifically related to the Satellite Power System (SPS), to assess performance of selected control concepts, and to identify and initiate development of advanced control technology that would enhance feasibility and performance of the SPS system. The initial stages of such a study are reported.

36465 (CONF-801102—8) **Comparison of major characteristics of OTEC power systems.** Leitner, M.I.; Robidart, C.M. (Lockheed Missiles and Space Co., Sunnyvale, CA (USA)). 1980. Contract AC03-77ET20299;AC01-78ET21056. 18p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

In the course of its participation in various OTEC-related activities, both company and Government funded, Lockheed Ocean Energy Systems have had occasion to investigate two distinct approaches to the design of the power system. In 1977, LMSC was awarded one of the design study contracts for Power System Development (PSD)-I, which had the objective of utilizing shell and tube heat exchangers to develop a viable OTEC power plant. In 1978, LMSC received one of the design study contracts for Power System Development (PSD)-II, which differed from PSD-I in that it required incorporation of compact or shell-less heat exchangers into the power system. A comparison of the major characteristics of the power system, particularly in regard to the heat exchangers, is presented. These characteristics include, but are not limited to, relative heat transfer characteristics, size, cost-effectiveness, and fluid flow requirements.

36466 (SERI/TP—631-664) **Analysis of the mist lift process for mist flow open-cycle OTEC.** Davenport, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-77CH00178. 10p. (CONF-801102—24). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Preliminary results are presented of a numerical analysis to study the open-cycle mist flow process for ocean thermal energy conversion (OTEC). Emphasis in the analysis is on the mass transfer and fluid mechanics of the steady-state mist flow. The analysis is based on two one-dimensional models of the mist lift process: a single-group model describes a mist composed of a single size of drops and a multigroup model considers a spectrum of drop sizes. The single-group model predicts that the lift achieved in the mist lift process will be sensitive to the inlet parameters. Under conditions that lead to maximum lift in the model for a single drop size, the multigroup model predicts significantly reduced performance. Because the growth of drops is important, sensitivity of the predicted performance of the mist lift to variations in the collision parameters has been studied.

36467 **Dynamic positioning of sea thermal power plants by jet propulsion .** Anderson, J. (to Sea Solar Power). US Patent 4,209,991. 1 Jul 1980. Filed date 19 Sep 1978. vpp.

A description is given of a sea thermal power plant having depending inlet pipes terminating in heat exchangers having adjustable deflectors with a pump in said pipes for forcing water through said pipes and heat exchangers to produce thrust directed by said deflectors in any desired direction for moving the plant over the water surface, means provided in said pipes downstream of said pumps for directing the greater portion of the water flowing through said pipes into the sea under the action of said pumps to produce higher thrust than that obtainable through the heat exchangers.

36468 **Open cycle ocean thermal energy conversion steam control and bypass system .** Jennings, S.; Wittig, J. (to Dept. of Energy). US Patent 4,210,819. 1 Jul 1980. Filed date 17 Aug 1978. vpp.

A description is given of an open cycle ocean thermal energy conversion system comprising: an axial flow turbine having a rotor whose axis of rotation is vertical and radially inner and outer casing structures which therebetween define an annular motive fluid path, said rotor including an annular array of radial blades extending across said fluid path; a condenser in fluid communication with said annular motive fluid flow path for condensing the motive fluid expanded through the turbine blades; a flash evaporator disposed about the turbine's axis of rotation, said evaporator having a generally toroidal-shaped casing, the interior of said casing being in fluid communication with said condenser both through and in bypassing relationship with said turbine blades; first means for regulating motive fluid flow from said evaporator to said condenser through said turbine blades; and second means for regulating bypass motive fluid flow from said evaporator to said condenser.

36469 **Open cycle ocean thermal energy conversion system structure .** Wittig, J. (to Dept. of Energy). US Patent 4,210,820. 1 Jul 1980. Filed date 17 Aug 1978. vpp.

An open cycle, ocean thermal energy conversion system is described, comprising: an axial flow turbine having a substantially vertical rotatable shaft about which at least one axial row of radial blades is disposed, an annular steam inlet structure through which motive steam is supplied to said turbine blades, and a steam outlet structure through which motive steam is exhausted after expansion through said blades; a flash evaporator disposed about the turbine's shaft, said evaporator having a generally toroidal-shaped casing, an inlet opening in a radially outer portion of said casing through which relatively warm ocean water is received, a portion of said warm ocean water being flashed into steam and transmitted through said turbine steam inlet structure, the unflashed warm ocean water being drained from said evaporator casing through a drain outlet disposed in a radially inner portion of said casing, said water assuming a substantially radial flow direction from the inlet to the outlet; a substantially annular condenser disposed axially adjacent said turbine about said turbine's axis of rotation, said condenser including radially inner and outer tube sheets, a plurality of tubes extending therebetween, a condensate sump disposed under said tubes for collection of condensed motive steam, and an outlet manifold, said inner tube sheets and said steam outlet structure cooperating to form an inlet manifold for distributing relatively cold ocean cooling water to the tubes, said cooling water traversing the tubes and exiting therefrom into the outlet manifold disposed radially adjacent said outer tube sheets; a generator driven by said turbine for producing electrical energy; first propulsion means for circulating relatively warm ocean water through said evaporator's inlet opening and drain outlet; and second propulsion means for circulating the cooling water through said condenser's inlet and outlet manifolds.

SOLAR THERMAL UTILIZATION

36470 (CONF-800491—, pp 614-617) **Research on the use of solar energy in the Department of Engineering Thermophysics, China University of Science and Technology.** Guo, K.L. (Univ., of Alabama, Huntsville); Ge, X.S. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36471 (NP—25005, pp 5p, Paper 8) **Research in the area of renewable sources of energy at Jyoti.** Jain, B.C. (Jyoti Ltd., Baroda, India). 1980.

In Nonconventional sources of energy: notes on short-term course.

Research activities in the following areas are described briefly: solar hot water systems, solar hot air systems, solar low pressure steam systems, solar-powered cold storage, solar thermal power generation, wind power, bio-gas plants, rural energy centers, and photovoltaic systems. The facilities at Jyoti are listed. (WHK)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 36291, 36808, 36820

36472 (AD-A—079906/4) **Computer simulation of a solar energy system which utilizes flat-plate solar collectors. Master's thesis.** Prins, B.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1979. 102p. NTIS, PC A06/MF A01.

This thesis is a computer simulation of a solar energy system that utilizes flat-plate solar collectors. By using available data from the U.S. Weather Bureau, the location and orientation of the collector, characteristics of the collector, and the type of storage and backup heat system in use, it is possible to find the amount of solar energy collected and transferred to storage. A life cycle cost analysis can be accomplished by using financial data and an inflation-discount function to reduce all costs to present year dollars. By varying any of a number of parameters the operator can determine what effect it has on the amount of energy collected and the life cycle costs. Results of running the program for a solar water heater system indicate that such a system is cost effective, when compared to a gas water heater system, only when the federal and state tax incentives were taken into account. However, electricity is approximately three times as expensive as gas per BTU of energy gained so the solar energy system is economically feasible when compared to an electric water heating system.

36473 (DOE/NASA/CR—161539) **Solar energy system performance evaluation: seasonal report for Colt Yosemite, Yosemite National Park, California.** (IBM Federal Systems Div., Huntsville, AL (USA)). Aug 1980. Contract AI01-76CS31037. 89p. NTIS, PC A05/MF A01.

The Solar Energy System, Colt Yosemite, was designed to provide 52% of the heating (2500 sq ft area) for the Visitors Center

at Yosemite National Park, California. The system consists of 980 sq ft of Colt A-151 series flat-plate liquid collectors, a petroleum-base thermal energy transport fluid, a 2500 gallon water-filled solar energy storage tank, heat exchangers, pumps, controls and associated plumbing. Solar heated water is pumped through a liquid-to-air heat exchanger in the space heating supply duct. Auxiliary hot water is provided from an oil-fired boiler to a second liquid-to-air heat exchanger when the solar energy is not sufficient to meet the space heating demand. There are four modes of system operation.

36474 (DOE/NASA/CR—161546) **Solar Energy System Performance Evaluation: seasonal report for Wormser, Columbia, South Carolina.** (IBM Federal Systems Div., Huntsville, AL (USA)). Aug 1980. Contract AI01-76CS31037. 91p. NTIS, PC A05/MF A01.

The Wormser Solar Energy System located in a four unit townhouse apartment (5400 square feet) in Columbia, South Carolina was designed to provide 50% of the hot water and 70% of the space heating by the Wormser Scientific Corporation, Stamford, Connecticut. The Solar Energy System consists of 266 ft^2 of pyramidal optics, flat-plate liquid collectors, a solar window area of 1152 ft^2, a 2500 gallon thermal water storage tank, an energy transport system (water), heat exchangers, pumps, controls and four domestic hot water (DHW) tanks. Electrical elements in each domestic hot water tank provide necessary auxiliary energy for hot water. Four multifunctional heat pumps, supplied with solar heated water provide space heating energy to the apartments, collector freeze protection is provided through the location of the collectors inside the attic. The system with six modes of operation became oprational in February 1978. The following topics are discussed: system description, performance assessment, operating energy, energy savings, maintenance, summary and conclusions.

36475 (DOE/PE—03871-01, pp 4.1-4.31) **Solar heating and cooling.** Nov 1979.

In Distributed energy systems: a review of related technologies.

An assessment of the technology and economics of solar space heating and cooling and water heating and industrial process heat is given. Solar collectors and heat storage systems are reviewed. (WHK)

36476 (EPRI-EM—1506-SY) **Solar heating and cooling of buildings (SHACOB): requirements definition and impact analysis-II.** Cretcher, C.K. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Sep 1980. 53p. NTIS, PC A04/MF A01.

A study conducted to determine the potential impact of the widespread implementation of solar heating and cooling systems on the utility load, utility operating costs, and customer costs for the years 1990 and 2000 is summarized. The study concluded that although results and recommendations vary among the utilities and regions studied, SHACOB installations can result in reduced electric demand. In addition, savings in utility operating costs and capital requirements for new plant construction may accrue to the utilities.

36477 (LA-UR—80-2556) **Performance estimation using correlation methods.** Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800972—4). NTIS, PC A02/MF A01.

From 1980 Department of Energy passive and hybird solar energy program update meeting; Washington, DC, USA (21 Sep 1980).

Correlation methods of prediction have advantages in greatly simplifying the time and complexity of performance predictions of passive solar buildings but are severely constrained in the number of variables which can be considered. Their accuracy is generally adequate for design purposes provided they are applied to buildings which correspond reasonably closely to the reference designs used in developing the correlations. The most simplified correlation procedures (such as the SLR method) are amenable to use with hand calculators, especially if pre-calculated tables are available corresponding to the weather data for the location of interest. When reporting the results of these calculations, the designer should be especially careful to specify the range of validity of the analysis, especially as pertains to both operating characteristics and design parameters. Correlation techniques are especially amenable to use in microcomputer routines which can be used in a design office. Very quick answers can be obtained during the schematic design and design development phases of a building to aid in deciding between different design options. This would include trade-offs between various conservation options and passive solar options.

36478 (LA-UR—80-2687) **LASL passive program.** Neeper, D.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800972—2). NTIS, PC A02/MF A01.

From 1980 Department of Energy passive and hybird solar energy program update meeting; Washington, DC, USA (21 Sep 1980).

Recent accomplishments are outlined on the following tasks: (1) solar load ratio for sunspaces; (2) thermal performance of components and buildings; (3) convective loop test; (4) similarity study of interzone convection; (5) evaluation of phase-change thermal storage; (6) off-peak electrical auxiliary heating; (7) passive solar design handbook; (8) program support to DOE; and (9) passive cooling for residences. (WHK)

36479 (LBL—10825) **Dynamic modeling and experimental simulation of active solar energy systems for the evaluation of control strategies.** Schiller, S.R.; Warren, M.L.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 9p. (CONF-801102—26). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Dynamic modeling and experimental simulation are used to evaluate control strategies for active solar energy systems. Performance of proportional and on/off collector loop controllers are evaluated and compared using a theoretical dynamic collector model. Use of the experimental test facility at Lawrence Berkeley Laboratory for evaluating the affect of controls and control strategies on hydronic space heating system performance is also discussed. Both the computer model and the test facility allow evaluation of control strategies using various flow rates, controller set points, insolation patterns, ambient temperature conditions, and collector types. The test facility also allows comparison of collector and load loop flow strategies based on various system configurations and building load demands.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 36475, 37078

36480 (NP—25005, pp 14p, Paper 5) **Solar thermal energy: three applications. A review.** Mahajan, S.P. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

System requirements for industrial solar process heating systems are discussed. Solar ponds with and without salinity gradients are discussed, and a solar still for distillation of seawater is briefly described. (WHK)

WATER HEATING

REFER ALSO TO CITATION(S) 36472, 36475

36481 **Water flow controller device.** Fender, W. (to Solardyne Inc). US Patent 4,210,125. 1 Jul 1980. Filed date 14 Aug 1978. vpp.

A description is given of a water flow controller device of the type used for connecting a solar collecting device to conventional facility plumbing and a water reservoir, which comprises: (A) a cold water source connector; (B) a hot water feed connector; (C) a collector supply connector; (D) a collector return connector; (E) a cold water inlet connector; (F) a bifurcated hot water outlet connector having a collector return channel and a hot water feed channel; (G) cold water line means connecting said cold water source connector to said cold water inlet connector; (H) collector supply line means connecting said collector; supply connector to said cold water lines means; (I) hot water line means connecting said hot water feed channel of said bifurcated hot water outlet connector to said hot water feed connector; (J) collector line means connecting said collector return channel of said bifurcated hot water outlet connector to said collector return connector; (K) means for circulating water connected within said collector supply line means; (L) means for controlling said circulating means electrically connected to said circulating means; and (M) whereby said cold water source connector may be connected to a cold water source line of said facility plumbing; said hot water feed connector may be connected to a hot water feed line of said facility plumbing; said collector supply connector may be connected to a supply of said solar collecting devise; said collector return connector may be connected to a return line from said solar collecting device; said cold water inlet connector may be connected to a cold water inlet of said water reservior; and said bifurcated hot water connector may be connected to a hot water outlet of said water reservoir.

MISCELLANEOUS SOLAR APPLICATIONS

36482 **Solar desalination system .** Rhodes. W. US Patent 4,210,494. 1 Jul 1980. Filed date 3 May 1978. vpp.

In the solar desalination of salt water, a method is given comprising the steps of: (A) introducing salt water into a tank having a bottom wall and a transparent top cover, said salt water in said tank forming a body of said water having a top surface, the space in the tank above the top surface being occupied by a first mixture of air and water vapor; (B) withdrawing water from said body of water in the tank to maintain the top surface of the body of water

substantially constant; (C) heating the body of water and the first mixture of air and water vapor in the space above the top surface of the body of water by solar rays passing through the transport top cover of the tank; (D) withdrawing the first mixture of air and water vapor from said tank, the amount of water vapor in the mixture being such as to substantially saturate the air of the mixture; (E) condensing water vapor from the first mixture in a condenser; (F) withdrawing a second mixture of air with a residual amount of water vapor from the condenser and increasing the pressure thereof; and (G) forcing at a desired pressure said second mixture into a sparger located slightly above the bottom wall of the tank and in the body of water in the tank, said sparger having orifices through which the pressurized second mixture passes, and which second mixture is converted to small bubbles which pass upwardly through the water body to the top surface thereof and during such passage the air in the second mixture becomes heated and substantially saturated with water vapor transforming said second mixture to said first mixture.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 36297, 36305, 36408, 36453, 36480, 36808

36483 (ALO—4121-2) **Development of a Low-Cost Solar Panel using laminated polymer films. Final report, September 15, 1977-November 15, 1978.** Nelson, E.V.; Adams, G.J.; Elkins, W.; McLeod, A.H. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Mar 1980. Contract EG-77-C-04-4121. 116p. NTIS, PC A06/MF A01.

The objective of this program is to demonstrate the fabrication of an inexpensive single-glazed flat plate collector which is fabricated with thin polymer films in high speed production processes. Progress is reported on the following tasks: design analysis, materials selection, panel manufacturing, thermal performance testing, and applications and cost analysis. (WHK)

36484 (COO—4297-3) **Corrosion protection of solar-collctor heat exchangers with electrochemically deposited films. Final report, 15 May 1978-15 November 1979.** Koch, V.R.; Schnaper, G.H.; Brummer, S.B. (EIC Corp., Newton, MA (USA)). May 1980. Contract AC04-78CS34297. 67p. NTIS, PC A04/MF A01.

The goal of this program was the demonstration of a novel corrosion protection technique for the common solar collector metals: Al, Cu, and Fe as mild steel. This involves the electrochemical deposition of thin, adherent polymer films on the interior of heat-exchanger tubes by application of a current in the presence of a suitable organic monomer. Polyphenylene oxide (PPO) films were anodically deposited onto Cu and Fe coupons from methanolic media. However, defects in these films afforded poor corrosion protection. In an attempt to circumvent this problem, suitably functionalized PPO films were cross-linked via Schiff base formation in a subsequent chemical step. While these chemically modified PPO films were demonstrably more resistant to ethylene glycol H_2O media at elevated temperatures, they were eventually undetermined by the thermal transfer fluid. Cinnamaldehyde, a styrene-type monomre, has been successfully electrodeposited onto Al coupons. This process involved a constant, albeit unreferenced potential technique in which the Al is made the negative electrode. Cathodic deposition onto Al avoids passivating Al_2O_3 barrier coating formation, and is amenable to the cross-linking technique. Filmed and cross-linked Al samples stored at elevated temperatures resisted corrosive processes compared to unfilmed control samples. Pitting, however, was the ultimate fate of all filmed samples.

36485 (DOE/CS/32241—1) **Coaxial extrusion conversion concept for polymeric flat plate solar collectors. Final technical report, September 30, 1978-December 31, 1979.** Rhodes, R.O.; Chapman, N.J.; Chao, K.C.; Sorenson, K.F. (FAFCO, Inc., Menlo Park, CA (USA)). Jan 1980. Contract AC03-78CS32241. 221p. NTIS, PC A10/MF A01.

This study investigated materials and processes for fundamental improvements in flat-plate solar collector cost and performance. The goal was to develop a process for direct conversion of inexpensive raw materials into a completed solar collector unit, without labor intensive assembly operations. It was thought that materials carefully matched to the process and end-use environment would substantially reduce collector costs, as compared to conventional industry practice. The project studied the feasibility of a cost-effective, glazed solar collector, with low labor input, utilizing a coaxial extrusion of compatible polymeric materials. This study evaluated all considered materials for the desired application. In addition, there was a trial extrusion of the leading candidate glazing and absorber materials, which resulted in successfully performing a coaxial extrusion of one cell. At the time the study was conducted, there were no materials available that met the necessary requirements for the specified utilization. It was recommended that, if potentially compatible materials become available, further investigation into the suitability of those materials be researched. Then, if a suitable material was found, proceeding into Phase II would be recommended.

36486 (DOE/CS/35302—T1) **Black germanium selective absorber surfaces. Final technical report, September 1, 1978-June 30, 1979.** Messier, R.; Vedam, K.; Krishnaswamy, S.V. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Dec 1979. Contract AC04-78CS35302. 38p. NTIS, PC A03/MF A01.

Semiconductor films with an appropriate band gap ($\sim$ 0.5 to 1.25 ev) have a high absorption coefficient in the solar spectrum region and high transmission in the IR thermal-emission region and thus make nearly ideal selective absorbers. However, due to their high refractive index, semiconductor films have high reflectance above their absorption edge which limits their total absorption. A coating which would retain the advantages of the semiconductor's selectivity and also reduce the reflectance from the present values of 30 to 50% to a level of less than 2% would be a significant advancement in the state of the art. This study describes work on the preparation and characterization of structurally anisotropic black Ge films by rf-sputtering and postdeposition etching. It has been shown that by controlling the sputtering preparation conditions of noncrystalline Ge films the surface microstructure can be drastically altered by simply etching in 30% H_2O_2. The total reflectance of the resulting surface was reduced from about 45% to less than 1%. Furthermore, the films appear black over a wide range of angles of incidence (up to 45% from the normal). This flat black appearance is shown to be due to a dense array of aligned, needle-like protrusions which have an extremely high aspect ratio and both a cross-sectional area and a separation between the needles on th order of the wavelength of solar radiation. Black Ge films were obtained with a solar absorptance, α/sub S/, of greater than 0.99 in the best cases. Variation of α/sub S/ and ϵ/sub IR/ (IR emittance) with the thickness of the film and other preparation conditions is described. Further, the various microstructures are classified and understood on the basis of a structure zone model.

36487 (DOE/EIA—0174(80/1)) **Energy data report: solar collector manufacturing activity, January through June 1980.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1980. 46p. NTIS, PC A03/MF A03.

Total shipments of solar thermal collectors during the first half of 1980 were 8.83 million square feet produced by 223 manufacturers (including 43 nonrespondents). Compared to the previous 6-month period, producer shipments increased by 1.48 million square feet. During January through June 1980 shipments were 1.93 million square feet higher than in the period January through June 1979. Shipments by 12 photovoltaic manufacturers during the first half of 1980 totaled 1841 peak kilowatts.

36488 (DOE/ET/20247—T1) **Chemical vapor deposition of refractory metal reflectors for spectrally selective solar absorbers. Annual report, May 1, 1978-April 30, 1979.** Seraphin, B.O.; Carver, G.E. (Arizona Univ., Tucson (USA). Optical Sciences Center). May 1979. Contract AS04-76ET20247. 26p. NTIS, PC A03/MF A01.

Three methods are described to fabricate by chemical vapor deposition (CVD) molybdenum films which rival conventional mirror materials in their infrared reflectance. With an absolute reflectance of 97.4% at 10 μm, these Super Molybdenum films reflect better than any other molybdenum film previously reported. When deposited in the presence of oxygen, films of a reduced reflectance over the solar emission range result. If passivated and antireflected by a Si_3N_4 layer, such Black Molybdenum films are characterized by a solar absorptance value in excess of 90% and a thermal emittance value of 11% at 500°C. No deterioration of these values has yet been observed in ongoing tests after 1000 hours exposure to 500°C in a 1 Torr vacuum. Stacks containing Super Molybdenum as the reflector and amorphous silicon as the absorber have thus far survived 1000 hours in open air at 500°C.

36489 **Process and apparatus for making composite sheet and heat exchanger panels therefrom.** Winter, J. (to Olin Corp). US Patent 4,209,885. 1 Jul 1980. Filed date 28 Aug 1978. vpp.

A process is described for producing a metal composite adapted for use in heat exchanger panels comprising: providing at least two sheets of metal; cold rolling said sheets of metal together to a desired reduction in thickness to form a green bond therebetween; and immediately after said cold rolling, quickly cooling said green bonded sheets to a temperature at which bond enhancement due to a temperature increase in said sheets during said cold rolling will not occur.

36490 (SAND—79-2134) **Steady-state wind loading on parabolic-trough solar collectors.** Randall, D.E.; McBride, D.D.; Tate, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

Two wind tunnel force and moment tests have been conducted on parabolic-trough solar collector configurations. The two tests

were conducted in different flow field environments, one a uniform flow infinite airstream, the second a simulated atmospheric boundary layer flow with the models simulating a ground-mounted installation. The force and moment characteristics of both isolated single-module troughs and of trough modules within array configurations have been defined over both operational and stow attitudes. The influence of various geometric design parameters for collector modules and arrays has been established. Data indicate that forces and moments increase with mounting height and with trough aspect ratio. Collector modules interior to large arrays experience wind force reductions as high as 50 to 65%, while appropriate fences or berms surrounding the arrays can provide exterior modules with protection of this order.

36491 (SAND—80-0385C) **Frequency response analysis of fluid control systems for parabolic trough solar collectors.** Schindwolf, R. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 27p. (CONF-801102—5). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Previous studies of solar collector fluid control systems have utilized computer simulations of collector and piping dynamics to evaluate stability and response characteristics. To obtain reasonable simulation accuracy requires substantial computer memory and time, and is well beyond the capability of small desk-top computers. Here a linearized steady state frequency response is derived for parabolic trough collectors and for connecting piping, which can be used in standard gain-phase analyses to evaluate system stability and closed loop frequency response. The frequency response characteristics of a typical collector string and piping are used in a gain-phase analysis to get some insight into the effect on system stability of various system parameters such as controller gain, sensor and controller time constants, and sensor location.

36492 **Reduction of intensity variations on the absorbers of ideal flux concentrators.** Greenman, P. (University of Chicago, Enrico Fermi Institute, Chicago, Illinois 60637). ER-78-S-02-4657. *Appl. Opt.;* **19**: No. 16, 2812-2821(15 Aug 1980).

Although ideal concentrators such as the compound parabolic concentrator have the property that concentrated flux is uniformly distributed on the absorber when the angular acceptance is filled by the incident flux, the instantaneous flux distribution may be very nonuniform when illuminated by a point source. These nonuniformities may be reduced by texturing the surface with small distortions. The necessary reduction of concentrator throughput is small enough to allow such texture concentrators to accommodate a wide range of tolerances in concentrator efficiency and uniformity of the flux distribution. In particular, the suitability of such concentrators for some space applications is discussed. Results of measurements on a test model are presented that demonstrate the effective reduction of flux nonuniformities by reflectors that have been textured by a simple process. Two-stage concentrators for attaining high concentration ratios are shown to distribute the concentrated flux fairly uniformly across the absorber when illuminated by point sources within the field of view. Again the remaining nonuniformities may be removed by texturing the reflecting surfaces (entailing some reduction in concentrator efficiency).

36493 **Process and apparatus for making heat exchanger panels .** Breedis, J.; Mravic, B.; Winter, J. (to Olin Corp). US Patent 4,209,886. 1 Jul 1980. Filed date 28 Aug 1978. vpp.

A process is described for forming a heat exchanger having a desired pattern of inflated tubular passageways from an as-rolled composite metal panel in the absence of a stop weld pattern defining said tubular passageways, said panel comprising at least two sheets of metal having a bond therebetween which can be broken by inflation; said process comprising: inserting an inflation needle into said composite metal panel between said sheets; and following the insertion of said inflation needle placing said panel with said inflationneedle inserted therein into an inflation press including at least one die having a cavity defining said tubular passageways, in said panel; the sired pattern of tubular passgeways in said panel; the improvement wherein: said step of inserting said inflation needle into said composite metal panel comrpises: preventing excessive peeling-apart of said sheets of said composite metal panel upon insertion of said inflation needle, said step of preventing excssive peeling-apart of said sheets, comprising the steps of: providing a first clamping member and a second clamping member arranged to clamp said composite metal panel therebetween at an edge therof wherein said inflation needle is to be inserted, at least one of said clamping members including a slot defining an opening immediately adjacent to said panel of limited extent and extending inwardly said panel from said edge thereof; and inserting said inflation needle between said sheets of said panel in alignment with said slot; whereby the sheet of said panel which engages said at least one of said clamping members expands only in an area defined by said slot.

36494 **Solar energy collection .** Stark, V. US Patent 4,210,121. 1 Jul 1980. Filed date 15 Jun 1977. vpp.

A description is given of a lens system for concentrating solar energy comprising at least three lenses, a first of said lenses being an elongated lens located centrally of the others of said lenses and having an elongated focus, the others of said lenses being elongated fresnel-type lenses having longitudinal microprisms, and elongated foci, said fresnel-type lenses being positioned and said microprisims being arranged so that the foci of said fresnel-type lenses are substantially coextensive with said focus of said lens, and means for interconnecting said lenses for tracking movement, whereby the foci of said lenses remain substantially coextensive during tracking of the sun. Apparatus for collecting and concentrating solar energy comprising in combination collector means characterized by elongated conduited means comprising a plurality of conduits each containing a fluid therein, said conduits being arranged such that at least two fluids in the conduits are contiguous, and fluid lens means for concentrating the solar energy along an elongated focus at said collector means located substantially in or on and substantially along at least one of the conduits, said fluid lens means comprising a solar-energy transmitting lens fluid and opposed solar energy transmitting plates enclosing said lens fluid, said lens plates being spaced and said lens flui D being chosen to absorb a minimum amount of infrared solar energy, said lens fluid being chosen from the group consisting of solvents, hydrocarbons, and salt and water solutions, said lens fluid having an index of refraction of greater than about 35, and said lens means further selectively comprising means for protecting lens plates otherwise corroded by said lens fluid.

36495 **Energy conversion apparatus .** Artweger, W. (to Artweger Industrie Gesellschaft Mbh (Austria)). US Patent 4,210,122. 1 Jul 1980. Priority date 11 Aug 1976, Austria, vpp.

A modular energy conversion apparatus for converting solar into thermal energy, comprising a plurality of detachably interconnected modules, each module comprising (A) an energy conversion unit arranged for exposure to solar radiation and defining a cavity capable of receiving a heat carrier fluid, the unit including (1) an inlet and an outlet for the fluid in communication with the cavity, and (2) the inlet and the outlet each having a coupling part, and (B) a mounting element carrying the energy conversion unit and including (1) a conduit portion embedded therein, and having an inlet and an outlet end, (2) the inlet and outlet ends of the conduit portion each having a coupling part, (3) the inlet end coupling part and the outlet coupling part, on the one hand, and the outlet end coupling part and the inlet coupling part, on the other hand, being matched for detachable assembly to form detachable joints between respectively registering pairs of the coupling parts for detachably assembling the energy conversion unit and the mounting element, and (4) one of the detachable joints detachably assembling adjacent ones of the mounting elements, registering ones of the coupling parts forming the one detachable joint, the conduit portions detachably joined to the cavities forming a conduit system for the heat carrier fluid to and from the cavities.

36496 **Solar energy collector .** Kellberg, H.; Wilder, A. (to Corning Glass Works). US Patent 4,210,126. 1 Jul 1980. Filed date 9 Mar 1978. vpp.

A description is given of a solar energy collector structure comprising: a plurality of partially evacuated tublar members substantially transparent to incident solar radiation, said tubular members having opposed lateral ends being arranged in a first and second group and lying adjacent one another in parallel axial alignment, means for joining each tubular member next to each adjacent tubular member of the group to form a first and second respective tube sheet structure; said tube sheets arranged adjacent each other in tendem to form at least one flow channel therebetween in a self-supporting structure; an absorber member disposed within said flow channel for intercepting and absorbing solar energy; and an insulating film having deposited theron a radiation reflecting substance located behind said absorber member disposed over and conforming closely to a surface of said second tube sheet for forming an insulating space between the insulating film and the second tube sheet to thereby suppress radiation, conduction and convection from said absorber in a direction out of the interior of the flow channel.

36497 **Heat exchanger panel having reference indicia and improved flow distribution.** Kleine, C.; Middleton, V. (to Olin Corp). US Patent 4,210,127. 1 Jul 1980. Filed date 22 Jun 1978. vpp.

In a heat exchanger panel for use in a solar energy collector system, said panel comprising a plurality of spaced parallel individual tubular passageways connecting opposed headers defined by numerous island-like bonded portions connected by a plurality of tubular channels passing therebetween, the boundaries of said headers defining a generally triangular shape with at least one of said boundaries being inclined with respect to an edge of said panel, said headers including entry and exit portions to said panel, siad entry and exit portions being laterally displaced from the center of said panel to permit a heat exchange medium to flow into said panel anc across said headers so that said medium flows through each of th

plurality of spaced parallel indiviual tubular passageways connecting said headers; and said parallel individual tubular passageways being interconnected by further tubular interconnecting portions spaced from said headers the improvement wherein said tubular interconnecting portions are arranged across said panel at an inclination generally corresponding to the inclination of said at least one boundary.

36498 Black liquid absorbing solar collector . Mattson, J. (to Solarspan Inc). US Patent 4,210,128. 1 Jul 1980. Filed date 30 Aug 1978. vpp.

A description is given of a solar to thermal energy converter for use in solar energy collector systems comprising an upper and lower surfaces transparent to solar energy and defining a plurality of elongate channel means therebetween for exposing a solar energy absorber heat transfer fluid to solar radiation, a solar energy absorber heat transfer fluid comprisng a black liquid absorber for converting solar energy to thermal energy and absorbing said thermal energy upon exposure to solar radiation, inlet means for introducing said black liquid absrober to said channel means, means for passing said black liquid absorber through said channel means, outlet means for conveying said black liquid absorber and absorbed thermal energy away from said channel means, said upper and lower channel means surface being sufficiently flexible to accommodate thermal expansion, and means disposed in said upper and lower surfaces defining conduit means transverse to said channel means and communicating with said channel means for adjusting the pressure and flow of said black liquid absorber along said channel means.

36499 Solar heat collector. O'hanlon, E. US Patent 4,210,129. 1 Jul 1980. Filed date 30 May 1978. vpp.

A description is given of a solar heat collecting assembly comprisng: a thin-walled, hollow container including a plurality of attached, metallic side walls and a metallic bottom wall extending between end portions of each of said side walls for partially defining a solar heat collecting space therbetween; a substantially rigid layer of high density plastic foam completely convering surface portions of said side walls and said bottom wall facing said solar heat collecting space for preventing the transfer of heat through said side walls and said bottom wall, respectively; a layer of highly reflective material mounted on all surface portions of said plastic foam facing said heat collecting space; a sheet of heat transmitting material completely covering said heat collecting space and having end portions fixedly attached to confronting end surfaces of said high density plastic foams; a pair of parallel extending screen assemblies positioned within said solar heat collecting space and extending substantially parallel to said bottom wall of said hollow container, each screen assembly having end portions attached to said layer of highly reflective material and each screen assembly having openings sufficient to allow the passage of low micron heat waves therethrough; tube means positioned between said parallel extending screen assemblies, with said tube means havng opposite end portions each extending through a separate opening in a wall of said hollow container for providing a liquid flow passageway through said heat collecting space and between said screen assemblies, whereby heat captured by said tube means and said screen assemblies is transferred to the liquid flowing through said tube means.

36500 Solar collector with multi-turn collecting strips . Boodley, N.; Hanshaw, F. US Patent 4,210,130. 1 Jul 1980. Filed date 20 Jan 1978. vpp.

A description is given of a solar collector for collecting energy from the sun and transferring the energy to a transfer fluid, said solar collector comprising: a collecting box, said box having inlet and outlet means for said transfer fluid and including an insulated bottom, side walls extending upwardly from said bottom, and a light transmissive cover, said bottom, sides and cover defining an air tight space, inner surfaces of said bottom and side walls being collecting surfaces; a plurality of multi-turn helical collecting strips secured to said inner surface of said bottom of said collecting box, each of said helical collecting strips having a strip width of between about 1/4 and 3/4 inch and a strip length of between about 2 and 12 inches and forming an infinite number of parabolic surfaces, each of said parabolic surfaces absorbing a portion of the rays from the sun striking it, rays reflected from said parabolic surfaces being collected and concentrated at the focal length of said parabolic surfaces to form areas of elevated temperature; and means for causing flow of said transfer fluid through said collecting box whereby heat collected in said box by said inner surfaces of said walls and bottom, said multi-turn collecting strips, and concentrated at the focal length of said parabolic surfaces is transferred to said transfer fluid and is removed from said solar collector.

36501 Multimode solar energy collector and process. Escher, W. US Patent 4,210,463. 1 Jul 1980. Filed date 11 Jan 1979. vpp.

A description is given of a multimode solar energy collector comprising: a transparent tubular body portion having end closures sealing each end of said body portion providing a fluid-tight cavity within the tube, a concentrator-reflector within the tube, a focal-line solar energy absorber in the focus of said concentrator-reflector, means for removal of absorbed energy from said focal-line solar energy absorber to the exterior of said tube, a diffuse sol ar energy absorber within the tube adapted to be in the path of reflected or diffuse solar radiation, a low temperature fluid conduit in thermal exchange relation with said diffuse solar energy absorber, heat exchanger fluid in said conduit and means for introducing and withdrawing the heat exchange fluid from said collector, said concentrator-reflector adapted to be in the path of direct solar radiation and focusing said direct radiation of said focal-line absorber and said diffuse absorber adapted to be in the path of reflected or diffuse solar radiation. The multimode solar energy collector of claim 1 wherein said focal-line energy absorber is coated with a photovoltaic material or fitted with photovoltaic cells directly converting the solar energy into electrical energy. The multimode solar energy collector of claim 1 wherein said concentrator-reflector is in movable relation to the tube.

36502 Process for preparing improved silvered glass mirrors. Buckwalter, C.Q. Jr. (to Dept. of Energy). US Patent Application 115,868. 28 Jan 1980. 13p.

Glass mirrors having improved weathering properties are prepared by an improvement in the process for making the mirrors. The glass surface after it has been cleaned but before it is silvered, is contacted with a solution of lanthanide rare earths in addition to a sensitization solution of tin or palladium. The addition of the rare earths produces a mirror which has increased resistance to delamination of the silver from the glass surface in the presence of water.

36503 Coatings for enhanced photothermal energy collection. I. Selective absorbers. Lampert, C.M. (Univ. of California, Berkeley). *Sol. Energy Mater.;* **1**: No. 5-6, 319-341(Jun 1979).

Several varieties of commercial and research selective absorbers are reviewed and tabulated for application. For many of these coatings, detailed reflectance, emittance and thermal stability data are presented. Selective coatings can take advantage of various optical absorption methods including light trapping, particulate coatings, semiconductor-metallic layers, multilayer films, quantum size effects and intrinsic absorption. The results of this study revealed many promising low temperature (150 to 300°C) absorber coatings along with a few highly engineered coatings which can withstand temperatures above 500°C.

36504 CVD molybdenum thin films in photothermal solar converters. Carver, G.E. (Univ. of Arizona, Tucson). *Sol. Energy Mater.;* **1**: No. 5-6, 357-367(Jun 1979).

Molybdenum thin films deposited by pyrolytic decomposition of molybdenum carbonyl are discussed. These films attain, after anneal in a reducing atmosphere at 1000°C, infrared reflectance values within 0.7% of the reflectance of supersmooth bulk molybdenum. This result combines the refractory nature of molybdenum with the high infrared reflectance generally associated with conventional mirror materials. The entire production sequence proceeds at one atmosphere pressure and requires less than one hour. Films deposited under oxidizing conditions exhibit a solar absorptance of a = 0.77 and a thermal emittance of e = 0.44. Absorptances of a = 0.82 with e = 0.08 are obtained by first annealing and then overcoating these black molybdenum films with an antireflecting layer. Changes in the optical properties during annealing are related to compositional and structural properties of the films, as determined by x-ray diffraction, electron microscopy and Auger spectroscopy.

36505 Temperature variation of the absorption edge of CVD amorphous and polycrystalline silicon. Janai, M.; Karlsson, B. (Univ. of Arizona, Tucson). *Sol. Energy Mater.;* **1**: No. 5-6, 387-395(Jun 1979).

Amorphous silicon films were prepared by the pyrolytic decomposition of silane (CVD). Their optical reflectance and transmittance in the near-infrared and in the visible regions were measured at temperatures between -25 and 500°C. Optical absorption profiles and refractive indices of the films were calculated, and the thermal red shift of the absorption profile was determined. These measurements were repeated following crystallization of the silicon films. The significance of the results for thermal conversion of solar energy with CVD silicon as the absorbing material is discussed.

36506 Temperature dependence of the emissivity of transition metals. Sievers, A.J. (Cornell Univ., Ithaca, NY). *Sol. Energy Mater.;* **1**: No. 5-6, 431-439(Jun 1979).

Measured dc electrical resistivities are used to obtain lower bounds to the temperature dependent emissivities of transition metals. Below 1000°K, good agreement is obtained between theory and experimental results if a charge density of one free electron per atom is assumed.

HEAT STORAGE

REFER ALSO TO CITATION(S) 36497

36507 (NP—25005, pp 9p, Paper 6) **Solar energy storage systems.** Mahajan, S.P. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Water tank storage, pebble bed heat storage, adsorbent beds, and thermochemical storage of solar energy are discussed. The thermodynamics of thermochemical heat storage and criteria for selection of thermochemical reaction are discussed. (WHK)

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 36778

36508 (LBL—8648) **Earth Sciences Division. Annual report 1978.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 258p. NTIS, PC A12/MF A01.

Progress is reported on geothermal energy development, geosciences, and underground nuclear waste management. Fifty-one energy-related projects are listed by title for EDB. (MHR)

GEOLOGY AND HYDROLOGY OF GEOTHERMAL SYSTEMS

USA

REFER ALSO TO CITATION(S) 36521

36509 (DOE/ET/28392—40) **Geology of the central Mineral Mountains, Beaver County, Utah.** Sibbett, B.S.; Nielson, D.L. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Mar 1980. Contract AC07-78ET28392. 178p. (ESL—33). NTIS, PC A09/MF A01.

The Mineral Mountains are located in Beaver and Millard Counties, southwestern Utah. The range is a horst located in the transition zone between the Basin and Range and Colorado Plateau geologic provinces. A multiple-phase Tertiary pluton forms most of the range, with Paleozoic rocks exposed on the north and south and Precambrian metamorphic rocks on the west in the Roosevelt Hot Springs KGRA (Known Geothermal Resource Area). Precambrian banded gneiss and Cambrian carbonate rocks have been intruded by foliated granodioritic to monzonitic rocks of uncertain age. The Tertiary pluton consists of six major phases of quartz monzonitic to leucocratic granitic rocks, two diorite stocks, and several more mafic units that form dikes. During uplift of the mountain block, overlying rocks and the upper part of the pluton were partially removed by denudation faulting to the west. The interplay of these low-angle faults and younger northerly trending Basin and Range faults is responsible for the structural control of the Roosevelt Hot Springs geothermal system. The structural complexity of the Roosevelt Hot Springs KGRA is unique within the range, although the same tectonic style continues throughout the range. During the Quaternary, rhyolite volcanism was active in the central part of the range and basaltic volcanism occurred in the northern portion of the map area. The heat source for the geothermal system is probably related to the Quaternary rhyolite volcanic activity.

36510 **Low-Grade Geothermal Project: geological feasibility study, Regina-Moose Jaw Area, Saskatchewan.** Vigrass, L.W.; Kent, D.M.; Leibel, R.J. (Univ. of Regina, Saskatchewan). pp 142p, Paper 1 of Geothermal services of Canada. Ottawa, Canada; Department of Energy, Mines and Resources Canada (1978).

The potential for hot water production from deep aquifers in the Regina-Moose Jaw area has been assessed. Data produced by the oil, gas and potash industries and one short seismic experiment were used. The best aquifer is in the Winnipeg formation at a depth of 2040 m and a temperature of about 71°C. Predicted flow is 300 m^3/hr with a drawdown of 300 m. The Deadwood formation below the Winnipeg is less well known, but it should yield significant hot water. Salinity of these aquifers is about 150,000 ppM. The results indicate that economic use for heating large buildings is possible.

NON-USA

36511 (LBL—8648, pp 106-110) **Mexican-American cooperative program at the Cerro Prieto geothermal field, Baja California, Mexico.** Lippmann, M.J.; Witherspoon, P.A.; Wollenberg, H.A. 1978.

In Earth Sciences Division. Annual Report 1978.

36512 (LBL—8648, pp 124-128) **Subsurface geology of the East Mesa geothermal anomaly.** Howard, J.H.; Graf, A.N.; van de Kamp, P.C. 1978.

In Earth Sciences Division. Annual Report 1978.

36513 (SGP-TR—40, pp 229-240) **Preliminary results on a depletion model for the Gabbro Zone.** Brigham, W.E. (Stanford Univ., CA); Neri, G. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

One of the tasks in the ENEL/DOE joint agreement includes the development of reservoir evaluation methods which will be applicable to both United States and Italian steam reservoirs. The Gabbro Reservoir data have been studied and a new lumped parameter model of the reservoir has been developed. The preliminary results of the modelling efforts are summarized.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 36510, 36511

36514 **Well logs for geothermal development, benefit analysis.** Rigby, F.A.; Reardon, P. pp 11p, Paper CC of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

As part of the program to encourage development of domestic energy resources, the US DOE has established a program to improve interpretation of well logs taken in geothermal environments. Science Applications, Inc., was selected to analyze the benefits that might result from provision of improved data from geothermal well logs, in order to provide data for planning research and the application of funds. Using the geothermal development scenario of the DOE, SAI has identified several hundred million dollars worth of benefits that might be realized in the development of geothermal energy, through improved application of well logging. Benefits to all aspects of geothermal development, including exploration, resource assessment, reservoir modeling, plant design, environmental protection, drilling costs, and reservoir management and operation, are discussed. Sensitivity of geothermal assessment and development to parameters determinable from well logs are discussed. Much useful information can be developed by adaptation of techniques used in oil and gas reservoirs, but the different demands of geothermal development from hydrocarbon production also open up new data requirements. Emphasis is placed on describing the types of data needed to analyze and develop geothermal reservoirs.

36515 **Classification of geothermal reservoirs from the viewpoint of log analysis.** Sanyal, S.K. (Stanford Univ., CA); Wells, L.E.; Mathews, M. pp 20p, Paper HH of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

This paper proposes several possible classification schemes for geothermal reservoirs from the viewpoint of well log analysis, the hope being that the vast number of known geothermal reservoirs can be grouped into a small number of reservoir classes, each with its distinct set of log responses and typical log analysis problems. Each of the following reservoir and fluid properties was chosen as the basis of a classification scheme: lithology, fluid phase, fluid chemistry, reservoir temperature, pore geometry and certain overall geological factors. Each scheme is examined in detail as to its relevance to log analysis and the reservoir classes under each scheme are described. Examples are given from the United States. Logging problems for each class are discussed. Frequency of occurrence of each class is considered.

36516 **True formation temperature sonde (TFTS).** Vagelatos, N.; Steinman, D.K.; John, J. (IRT Corp., San Diego, CA). pp 19p, Paper LL of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

A conceptual design for a logging system providing a determination of the true formation temperature, and simultaneously the neutron adbsorption cross section and saturated porosity of an arbitrary formation has been developed. Estimates of the system performance specifications have been made. The relevant aspects of the underlying neutron thermalization theory used in this method are discussed. The technique utilized involves the use of a fast neutron source and three slow neutron detectors in the sonde. One of these is covered with cadmium, another is covered with gadolinium and the third is unfiltered. The method for processing the observed detector counts to determine the temperature, neutron absorption cross section and neutron moderating power of the formation has been developed. Measurements have been performed in the laboratory

using borehole models. The results verify the methodology and demonstrate the feasibility of the technique.

36517 Application of oilfield well log interpretation techniques to the Cerro Prieto Geothermal Field. Ershaghi, I. (Univ. of Southern California, Los Angeles); Phillips, L.B.; Dougherty, E.L.; Handy, L.L.; Mathews, M. pp 11p, Paper PP of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

This paper presents the application of oilfield type well log analysis to the Cerro Prieto Field, Mexico. The lithology in this field is relatively similar to oilfield systems. The suite of logs available for the four wells analyzed consist of DIL, FDC-Gamma Ray, CNL, and Saraband. Temperature data about the wells are sketchy, and the logs had been run under pre-cooled mud condition. In the absence of some key parameters, we devised a system of interpretation using a combination of graphical and numerical studies to study the logs. Results show that the computed wellbore data are significantly different than the recorded data on the log heading. The trend analysis of the conductivity log may lead to the establishment of the onset of the hydrothermally altered zone.

36518 Log comparison from geothermal calibration/test well C/T-1. Mathews, M.; Arney, B.; Sayer, S. (Los Alamos Scientific Lab., NM). pp 25p, Paper RR of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The Geothermal Log Interpretation Program (GLIP) has made the C/T-1 (Mesa 31-1) well in the East Mesa Geothermal Field available for use in quality control, testing, and calibrating wireline logging tools. The East Mesa Geothermal Field is located in the Imperial Valley of California approximately 30 km east of El Centro, California and 60 km north of the Cerro Prieto Geothermal Field, in Mexico. C/T-1 well is 1880 m (6175 ft) deep, is fully cased (7 5/8 inches O.D.), has a bottom hole temperature of approximately 165°C (330°F), and penetrates Plio-Pleistocene deltaic sandstones, siltstones, clays, and shales. Several suites of logs have been run in this well by different logging companies. These logs include: temperature, pressure, caliper, density, neutron, gamma-ray, and cement bond logs. A qualitative comparison is made between these logs, the detailed lithologic log, and the open hole logs run in this well. These data provide a background upon which future logging systems can be tested, quality controlled, and calibrated. 21 figures, 3 tables.

36519 Evaluation of a rhyolite-basalt-volcanic ash sequence from well logs. Sanyal, S.K. (Stanford Univ., CA); Juprasert, S.; Jusbasche, M. pp 14p, Paper TT of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

This paper reports an empirical and innovative approach toward evaluation of logs from a well of unusual lithology: rhyolites, basalt and volcanic ash. The study was based on Borehole Compensated Sonic, Compensated Neutron-Formation Density, Temperature and drill cuttings logs. About 5000 ft of the gamma ray log, and of the porosity logs were digitized and analyzed with the help of a computer. No standard matrix parameters were available for the lithologic components encountered in this well. However by a careful and synergistic analysis, the well was evaluated as regards its lithology, zonation and the location of fracture zones. Gamma ray and neutron responses were most useful for lithology discrimination in this well. The well section could be divided into 36 distinct zones based on lithologic and pore geometrical characteristics. Lithologies of each zone, particularly the ash content could be estimated. Several permeable zones were identified from the porosity, caliper and temperature log information and a rough estimate of the total thickness of permeable zones was possible. Most apparent permeable zones were found to occur below 9000 feet and were associated with basaltic layers.

36520 Comments on utility of geothermal well logs and an evaluation of the logs from COSO-BDH-1. Sheff, J.R. (Univ. of Lowell, MA); Upton, J.W. Jr. pp 18p, Paper XX of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The log evaluations reported are for a geothermal test well, COSO-BDH-1. The hole was drilled to a depth of 1346 ft (410 m) as part of the geothermal exploration of the COSO area for geothermal energy development. Data is reported on temperature in the hole, the hole diameter, the rock lithology, the formation density, the natural gamma ray emissions, the neutron log (generally used as a porosity indicator), and an acoustic log. The log analysis generally showed that inadequate data was taken for a complete analysis, but that definite signs could be found pointing to the utility of logging as an aid to geothermal resource evaluation. The interpretation of logs was hampered by inadequate models of expected log behavior in geothermal fields. Geothermal logging can be of more use in the future if the log interpretation methods are upgraded. Suggested are measurement of basic geothermal rock data, detailed log method calculations, test well calibrations, and more extensive and better data and modeling of exploration wells. 6 figures, 6 tables.

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 36538

36521 (DOE/ER/02534—6) Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1979-August 31, 1980. Aki, K. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1980. Contract AS02-76ER02634. 93p. NTIS, PC A05/MF A01.

Progress is reported in the following research areas: a synthesis of seismic experiments at the Fenton Hill Hot-Dry-Rock System; attenuation of high-frequency shear waves in the lithosphere; a new kinematic source model for deep volcanic tremors; ground motion in the near-field of a fluid-driven crack and its interpretation in the study of shallow volcanic tremor; low-velocity bodies under geothermal areas; and operation of event recorders in Mt. St. Helens and Newberry Peak with preliminary results from them. (MHR)

36522 (LBL—8648, pp 4-6) Electrical and electromagnetic computer modeling techniques. Lee, K.H.; Pridmore, D.; Hoversten, M.; Morrison, H.F. 1978.

In Earth Sciences Division. Annual report 1978.

36523 (LBL—8648, pp 7-8) Minicomputer for in-field processing of magnetotelluric data. Koch, R.H.; Goubau, W.M.; Gamble, T.D.; Miracky, R.F.; Clark, J. 1978.

In Earth Sciences Division. Annual report 1978.

36524 (LBL—8648, pp 8-9) Superconducting thin-film gradiometer and magnetometers for geophysical applications. Goubau, W.M.; Clarke, J. 1978.

In Earth Sciences Division. Annual report 1978.

36525 (LBL—8648, pp 9-12) Magnetotellurics with SQUID magnetometers. Gamble, T.D.; Goubau, W.M.; Miracky, R.F.; Clarke, J. 1978.

In Earth Sciences Division. Annual report 1978.

36526 (LBL—8648, pp 12-15) Controlled-source electromagnetic system. Morrison, H.F.; Goldstein, N.E.; Hoversten, M.; Oppliger, G.; Riveros, C. 1978.

In Earth Sciences Division. Annual report 1978.

36527 (LBL—8648, pp 15-19) Geothermal seismic field system development. McEvilly, T.V.; Majer, E.L.; Bartschi, J.; Heinson, J. 1978.

In Earth Sciences Division. Annual report 1978.

36528 (LBL—8648, pp 20-22) Klamath Basin geothermal resource and exploration technique evaluation. Goldstein, N.E.; Wollenberg, H.A.; Stark, M.A. 1978.

In Earth Sciences Division. Annual report 1978.

36529 (LBL—8648, pp 26-28) East Mesa seismic study. McEvilly, T.V.; Schechter, B.; Majer, E.L. 1978.

In Earth Sciences Division. Annual Report 1978.

36530 (LBL—8648, pp 29-33) Seismological studies at Cerro Prieto. Majer, E.L.; McEvilly, T.V. 1978.

In Earth Sciences Division. Annual Report 1978.

36531 (LBL—8648, pp 34-37) Self-potential studies at Cerro Prieto. Corwin, R.F.; Morrison, H.F. 1978.

In Earth Sciences Division. Annual Report 1978.

36532 (LBL—8648, pp 37-41) Resistivity studies at Cerro Prieto. Wilt, M.J.; Goldstein, N.E. 1978.

In Earth Sciences Division. Annual Report 1978.

36533 (LBL—8648, pp 41-43) Magnetotelluric survey at Cerro Prieto. Gamble, T.D.; Goubau, W.M.; Goldstein, N.E.; Clarke, J. 1978.

In Earth Sciences Division. Annual Report 1978.

36534 (LBL—8648, pp 43-45) Precision gravity surveys at Cerro Prieto. Grannell, R.B. (California State Univ., Long Beach); Tarman, D.W.; Goldstein, N.E. 1978.

In Earth Sciences Division. Annual Report 1978.

36535 **Geothermal services of Canada.** Ottawa, Canada; Department of Energy, Mines and Resources Canada (1978). 246p. (NP—25088). $78.00.

Four geothermal reports on the Regina-Moose Jaw Area of Saskatchewan are included. Separate abstracts were prepared for each one. (MHR)

36536 **Seismic data compilation and mapping of Regina Area for Energy Research Unit, University of Regina.** Surjik, D.L. (D.L. Surjik and Associates, Ltd., Saskatchewan, Canada). pp 7p, Paper 2 of Geothermal services of Canada. Ottawa, Canada; Department of Energy, Mines and Resources Canada (1978).

Seismic data on Department of Mineral Resources, Government of Saskatchewan files was gathered into a mapping study for determining a regional structural setting. In addition, private seismic data banks and their brokers were contacted unsuccessfully in Calgary for additional data which might be available for sale. Only processed data submitted to the government by various oil exploration companies since the 1950's was available for seismic mapping in the study area.

36537 **Seismic profile: University of Regina, Energy Research Unit.** Surjik, D.L. (D.L. Surjik and Associates, Ltd., Saskatchewan, Canada). pp 6p, Paper 3 of Geothermal service of Canada. Ottawa, Canada; Department of Energy, Mines and Resources Canada (1978).

A seismic profile and its interpretation report are presented. (MHR)

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 36954

36538 (LBL—8648, pp 23-26) **Mt. Hood geothermal resource evaluation.** Goldstein, N.E.; Wollenberg, H.A.; Bowman, H.; Mozley, E. 1978.

In Earth Sciences Division. Annual report 1978.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 36539, 36580

LEGAL AND INSTITUTIONAL ASPECTS

36539 (DOE/ET/27032—1) **Geothermal energy impact in Brazoria County. Final report, 15 July 1978-November 30, 1979.** Horine, B. (Alvin Community Coll., TX (USA)). Jun 1980. Contract AS08-78ET27032. 43p. NTIS, PC A03/MF A01.

All activities performed by Alvin Community College and the University of Texas at Austin in association with the development of Geopressured-Geothermal energy are contained in this report. A discussion of the progress of the Test Well is also contained herein. Public seminars and workshops were presented to the local community. A summer institute in energy was also presented to local public school teachers. A compaign to publicize the development of the new energy resource was also waged. An overall evaluation of the project is also attached.

36540 (DOE/ID/12017—2) **New Mexico handbook for geothermal resource development state and local government regulations.** (New Mexico Energy and Minerals Dept., Santa Fe (USA)). Jul 1980. Contract FC07-79ID12017. 69p. NTIS, PC A04/MF A01.

The regulatory aspects of a wide range of potential projects and sequences within the projects are covered, such as: exploration, demonstration, construction, commercialization, and operation. Such topics as environmental studies, water rights, district heating, taxation archaeological clearances, and construction permits are addressed. Other general information is provided which may assist a prospective geothermal developer in understanding which state and local agencies have review responsibilities, their review procedures, and the appropriate time frame necessary to complete their review process. (MHR)

36541 (DOE/RA—0050) **Geothermal Energy Research Development and Demonstration Program.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications). Jun 1980. 204p. (IGCC—5). NTIS, PC A10/MF A01.

The Federal program's goal, strategy, plans, and achievements are summarized. In addition, geothermal development by state and local governments and, where available, by the private sector is described. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

36542 (MTR—7689(App.)) **Comparative analysis of energy costing methodologies. Appendix: report on levelized busbar-costing workshop held at MITRE/Metrek, June 29-30, 1978.** Leigh, J.G. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1979. Contract AC01-77ET28505. 75p. NTIS, PC A04/MF A01.

The proceedings of a workshop on levelized busbar costing methodologies which was held at MITRE/Metrek on June 29 and 30, 1978 are described. Particular emphasis was placed on consideration of geothermal energy sources. The objective of the workshop was to determine whether a consensus could be developed regarding the most appropriate methodologies and assumptions for levelized energy costing. The workshop was attended by representatives from energy resource, utility and engineering design companies, and by representatives of the Division of Geothermal Energy and R and D contractors for this Division. It was found that year-by-year calculations in current dollars were generally preferred, using either Discounted Cash Flow or Revenue Requirements methods. No consensus emerged on choice of discount rate or financial parameters such as debt/equity ratio, and tax credit carry forward/carry back provisions. It was felt that engineering aspects deserve close attention.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

36543 (LBL—8648, pp 128-130) **Geothermal subsidence research program.** Simkin, T.L.; Noble, J.E.; Schwarz, W.J. 1978.

In Earth Sciences Division. Annual Report 1978.

36544 (UCRL—83823) **Geothermal power production: accidental fluid releases, waste disposal, and water use.** Layton, D.W.; Morris, W.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1980. Contract W-7405-ENG-48. 36p. (CONF-801104—1). NTIS, PC A03/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

Environmental problems related to the use and disposal of fluids can accompany the operation of geothermal power plants using hot water resources (temperature > 150°C). More than 100 kg of fluids must be extracted, processed, and disposed for each kW.h of electricity generated from a facility relying on a geothermal reservoir with fluids of 150°C. The low thermal efficiencies of geothermal power plants result in large requirements for cooling water - over 7.4 x 10^4 m^3/MW.y compared with 1.7 x 10^4 m^3/MW.y for coal-fired plants. Geothermal fluids can contain as much as 250,000 mg/l total dissolved solids. Toxic substances like boron and NH_3 are often present in fluids. This paper focuses on impacts associated with accidental releases of geothermal fluids as well as the disposal of liquid and solid wastes. The consequences of consuming alternative sources of cooling water are also addressed. Inadvertent discharges of fluids are of concern because they could contaminate soils and surface waters, adversely affecting crops and aquatic organisms. The pretreatment of fluids before subsurface injection could lead to solid waste problems - especially when toxic substances are produced. The consumption of alternative cooling waters can pose problems involving the disposal of blowdown from cooling towers. In addition, the toxicity of drift emitted from cooling towers depends on the kind of cooling water used.

36545 **Environmental impact report (draft).** Sacramento, CA; California Energy Commission (May 1980). 552p. (NP—25013).

The three projects as proposed by Pacific Gas and Electric Company and the environmental analysis of the projects are discussed. Sections on the natural and social environments of the proposed projects and their surrounding areas consist of descriptions of the setting, discussions of the adverse and beneficial consequences of the project, and potential mitigation measures to reduce the effects of adverse impacts. The Environmental Impact Report includes discussions of unavoidable adverse effects, irreversible changes, long-term and cumulative impacts, growth-inducing effects, and feasible alternatives to the project. (MHR)

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 36542

36546 (NP—25005, pp 32p, Paper 17) **Geothermal energy: potential and utilization.** Magal, B.S. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Some non-electric uses of geothermal energy are listed. Thermodynamic cycles, conversion systems, prime-movers for geother-

mal energy conversion, environmental factors, and geothermal developments in Europe are discussed. (MHR)

36547 (NP—25005, pp 6p, Paper 18) **Electric-power-conversion systems: binary-fluid cycles.** Mital, C.K. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Recent developments in binary-fluid systems for geothermal energy conversion are presented. (MHR)

DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 36544

36548 (LBL—8648, pp 60-65) **Thermodynamic and cost benefits of floating cooling for geothermal binary-cycle power plants.** Pines, H.S. 1978.

In Earth Sciences Division. Annual Report 1978.

POWER PLANT SYSTEMS AND COMPONENTS

36549 (LBL—8648, pp 47-50) **Heat transfer coefficients for isobutane.** Tleimat, B.W.; Laird, A.D.K.; Rie, H.; Hsu, I.C. 1978.

In Earth Sciences Division. Annual Report 1978.

36550 (LBL—8648, pp 50-51) **Field test of geothermal/hydrocarbon shell-and-tube heat exchangers.** Beaulaurier, L.O. 1978.

In Earth Sciences Division. Annual Report 1978.

36551 (LBL—8648, pp 55-57) **Developments in direct-contact heat exchange.** Fulton, R.L. 1978.

In Earth Sciences Division. Annual Report 1978.

36552 (LBL—8648, pp 57-59) **Heat-exchanger design optimization.** Pope, W.L. 1978.

In Earth Sciences Division. Annual Report 1978.

A new general surface heat-exchanger design relationship is presented which uniquely couples the optimum design fouling resistance and the optimum design overall heat transfer coefficient with the ratio of cleaning cost to capital plus operating costs at the optimum design condition.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

36553 (SAND—80-2026C) **Detection, diagnosis, and prognosis in geothermal well technology.** Veneruso, A.F.; Chang, H.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 11p. (CONF-801059—1). NTIS, PC A02/MF A01.

From 32. meeting of the mechanical failures prevention group; Santa Monica, CA, USA (7 Oct 1980).

For successful and safe operation of a geothermal well, the condition of the casing and cement must be accurately determined. Measurements on casing wall thickness, corrosion damage, holes, cracks, splits, etc., are needed to assess casing integrity. Cement bond logs are needed to detect channels or water pockets in cement behind pipe and to determine the state of the cement bond to the pipe and formation. Instrumentation for making such measurements is limited by the temperature capabilities (<175°C) of existing logging equipment developed for the oil and gas industry. The instruments that are needed for geothermal casing and cementing inspection are reviewed; the principle deficiencies in their high temperature use are identified; and Sandia's upgrade research program on multi-arm caliper and acoustic cement bond logging tool is described. The key electronic section in a multi-arm caliper will consist of 275°C circuits. In an acoustic cement bond logging tool, a simple circuit with possibilities of using commercially available components for high temperature operation is being developed. These new tools will be field tested for operation at a minimum temperature of 275°C and pressure of 7000 psi for up to 1000 hours.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 37436

36554 (PNL—3385) **Monitoring instrument field experiments at Oregon Institute of Technology.** Danielson, M.J.; Smith, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01.

The field tests were conducted under reducing and oxidizing conditions. Corrosion rates with zero oxygen were about 1.1 mils per year (mpy) for both copper and steel coupons, which is quite low for carbon steel. There was a problem controlling the oxygen level in the oxygenated experiments; however, it was found that corrosion rates increased with the presence of oxygen. Corrosion rates for the steel and copper coupons were 4 and 2 mpy, respectively; copper coupled to cast iron corroded at 8 mpy. Commercial corrosion rate measuring equipment determined the general corrosion rate of carbon steel farily well but overestimated copper corrosion rates. The redox electrode was a very sensitive indicator of the entry of oxygen.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 36513

36555 (CONF-8006103—1) **Methane entrained in geopressured aquifers, Texas Gulf Coast.** Morton, R.A. (Texas Univ., Austin (USA). Bureau of Economic Geology). Jul 1980. Contract AC08-78ET11397. 23p. NTIS, PC A02/MF A01.

From IIASA conference on world gas resources; Laxenburg, Austria (30 Jun 1980).

Six tests of geopressured aquifers have yielded between 3.6 to 4.5 m^3/m^3 (20 to 25 scf/bbl) of gas. These low gas concentrations are attributed to high salinities, that in all tests exceeded 100,000 mg/l, but undersaturated conditions cannot be ruled out completely. Research efforts are designed to delineate the geographic and stratigraphic variations in salinity and to recognize regional and local trends so that zones of lower salinity and higher gas concentration can be identified. Moreover, well logs and seismic data are being used to develop methods of detecting low concentrations of free gas in watered-out gas sands and in thin sands that were considered as noncommercial prior to renewed interest in unconventional gas supplies. (MHR)

36556 (LBL—8648, pp 68-70) **Pressure measurements using a fluid-filled capillary tube.** Miller, C.W. 1978.

In Earth Sciences Division. Annual Report 1978.

36557 (LBL—8648, pp 70-71) **Two-phase flashing flow in geothermal wells.** Juprasert, S. 1978.

In Earth Sciences Division. Annual Report 1978.

36558 (LBL—8648, pp 72-74) **Flow to a well intercepting a vertical fracture: validation of a numerical model.** Narasimhan, T.N.; Palen, W.A. 1978.

In Earth Sciences Division. Annual report 1978.

36559 (LBL—8648, pp 75-77) **Effect of radially varying transmissivity on the transient pressure phenomenon.** Mlodinow, L.D.; Tsang, C.F. 1978.

In Earth Sciences Division. Annual report 1978.

Pressure response calculations, which yield analytic expressions, are described in terms of a single integral for a wide class of physically reasonable permeability functions. (MHR)

36560 (LBL—8648, pp 77-79) **Mathematical simulation of thermal breakthrough under injection: comparison of two techniques.** Narasimhan, T.N.; Juprasert, S.; Bodvarsson, G.S. 1978.

In Earth Sciences Division. Annual Report 1978.

36561 (LBL—8648, pp 79-86) **Well test data analysis methods at LBL.** Benson, S.M.; Goranson, C.B.; Schroeder, R.C. 1978.

In Earth Sciences Division. Annual Report 1978.

36562 (LBL—8648, pp 86-93) **Summary of well tests and analyses for the East Mesa geothermal site.** Benson, S.M.; Goranson, C.B.; Haney, J.; McEdwards, D.G.; Narasimhan, T.N.; Schroeder, R.C. 1978.

In Earth Sciences Division. Annual Report 1978.

36563 (LBL—8648, pp 94-97) **Development of the simulator SHAFT78 for geothermal reservoir studies.** Pruess, K.; Schroeder, R.C.; Witherspoon, P.A.; Zerzan, J.M. 1978.

In Earth Sciences Division. Annual Report 1978.

36564 (LBL—8648, pp 97-106) **Site-specific geothermal reservoir engineering activities.** Goranson, C.B.; Schroeder, R.C. 1978.

In Earth Sciences Division. Annual Report 1978.

Progress in site-specific activities is reviewed for the following: Desert Hot Springs, Casa Diablo, Coso Hot Springs, Susanville anomaly, Klamath Falls, Cerro Prieto geothermal field, and East Mesa KGRA. (MHR)

36565 (LBL—8648, pp 111-119) **Preliminary simulation studies related to the Cerro Prieto field.** Lippmann, M.J.; Bodvarsson, G.S.; Witherspoon, P.A. 1978.

In Earth Sciences Division. Annual Report 1978.

36566 (LBL—8648, pp 119-124) **Study of alternative reinjection schemes for the Cerro Prieto geothermal field, Baja California, Mexico.** Tsang, C.F.; Bodvarsson, G.S.; Lippmann, M.J.; Rivera, J. 1978.

In Earth Sciences Division. Annual Report 1978.

36567 (LBL—8648, pp 130-135) **Geothermal reservoir engineering management program.** Howard, J.H.; Schwarz, W.J. 1978.
In Earth Sciences Division. Annual Report 1978.

36568 (LBL—8648, pp 135-139) **Study of groundwater temperature changes during aquifer uses related to power production.** Lippmann, M.J.; Tsang, C.F.; Witherspoon, P.A. 1978.
In Earth Sciences Division. Annual Report 1978.

36569 (LBL—8648, pp 139-143) **Mathematical modeling of thermal energy storage in aquifers.** Tsang, C.F.; Buscheck, T.; Mangold, D.C.; Lippmann, M.J. 1978.
In Earth Sciences Division. Annual Report 1978.

36570 **Compilation of industry-derived data on formation fluid and reservoir characteristics in the Regina Area.** Ruse, D. (Cavern Engineering Ltd., Saskatchewan, Canada). pp 26p, Paper 4 of Geothermal service of Canada. Ottawa, Canada; Department of Energy, Mines and Resources Canada (1978).

An attempt has been made to gather any information that might be of assistance to the University of Regina in the evaluation of their Geothermal Project. Considered is mainly Regina and the surrounding area although material from further away is included where it is thought to be of value. The information presented includes operating information on source and disposal wells, drill stem tests results and analysis of same, observations made on wells while drilling, temperatures from logs, source well operations and drill stem tests, and analyses of formation water samples. Where possible comments as to the reliability and limitations of information are included.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 36546

36571 (DOE/ET/27041—1) **Kelly Hot Spring Geothermal Project: Kelly Hot Spring Agricultural Center preliminary design. Final technical report.** Longyear, A.B. (ed.). (Geothermal Power Corp., Novato, CA (USA)). Aug 1980. Contract AC03-79ET27041. 120p. NTIS, PC A06/MF A01.

A Phase 1 Preliminary Design, Construction Planning and Economic Analysis has been conducted for the Kelly Hot Spring Agricultural Center in Modoc County, California. The core activity is a 1360 breeding sow, swine raising complex that utilizes direct heat energy from the Kelly Hot Spring geothermal resource. The swine is to be a totally confined operation for producing premium pork in controlled-environment facilities. The complex contains a feed mill, swine raising buildings and a complete waste management facility that produces methane gas to be delivered to a utility company for the production of electricity. The complex produces 6.7 million pounds of live pork (29,353 animals) shipped to slaughter per year; 105,000 cu. ft. of scrubbed methane per day; and fertilizer. Total effluent is less than 200 gpm of agricultural quality-water with full odor control. The methane production rate made possible with geothermal direct heat is equivalent to at least 400 kw continuous. Sale of the methane on a co-generation basis is being discussed with the utility company. The use of geothermal direct heat energy in the complex displaces nearly 350,000 gallons of fuel oil per year. Generation of the biogas displaces an additional 300,000 gallons of fuel oil per year.

36572 (JHU/APL-QM—80-102) **Geothermal energy development in the eastern United States: technical assistance report no. 5. Geothermal space heating-naval air rework facility, Norfolk, Virginia.** Hill, F.K.; Henderson, R.W. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Jun 1980. Contract AI01-79ET27025. 40p. NTIS, PC A03/MF A01.

The electronic integration hangar, designated LP-167, was selected for study, as it was a single-story building with a large floor area. Because of the high ceiling and the sliding doors necessary to admit aircraft, the heat loss rate, based on floor area, was about twice that of commercial buildings. It was furnished with an oil-fired hot water heating system capable of high thermal output to meet heating requirements in the coldest weather. On the basis of the known characteristics of geothermal sources for the Atlantic Coastal Plain, and wells drilled and assayed in the Norfolk area, a reasonable estimate of the parameters of a well drilled at NARF was made. This included a low temperature output from the well of only 107°F, so that direct transfer of warm water between the wellhead heat exchanger (HX) and the hot water radiating system in the building was not practical. Four design options are explored and calculations are presented on each one.

36573 (LBL—8648, pp 66-68) **Geothermal resources and the US pulp and paper industry.** Davey, J.V.; Howard, J.H. 1978.
In Earth Sciences Division. Annual Report 1978.

GEOTHERMAL DATA AND THEORY

36574 (LBL—8648, pp 52-54) **Thermodynamic and transport properties of light hydrocarbons and their binary mixtures.** Silvester, L.F. 1978.
In Earth Sciences Division. Annual Report 1978.

PROPERTIES OF AQUEOUS SOLUTIONS

36575 (LBL—8648, pp 158-160) **Thermodynamics of high-temperature brines.** Pitzer, K.S.; Bradley, D.J.; Rogers, P.Z.; Peiper, J.C. 1978.
In Earth Sciences Division. Annual Report 1978.

36576 (LBL—8648, pp 160-165) **Solubility of albite in the aqueous phase at elevated temperatures.** Neil, J.M.; Apps, J.A. 1978.
In Earth Sciences Division. Annual Report 1978.

36577 (LBL—8648, pp 168-169) **Development of a data base for aqueous solutions.** Otto, R.J.; Ozbek, H.; Phillips, S.L. 1978.
In Earth Sciences Division. Annual Report 1978.

36578 (LBL—8648, pp 169-173) **Kinetics of precipitation of amorphous silica from aqueous solution.** Weres, O.; Yee, A.; Tsao, L. 1978.
In Earth Sciences Division. Annual Report 1978.

PROPERTIES OF MINERALS AND ROCKS

36579 (LBL—8648, pp 165-168) **Thermodynamic properties of silicate materials.** Carmichael, I.S.E.; Ghiorso, M.S.; Moret, L.; Nelson. S.A. 1978.
In Earth Sciences Division. Annual Report 1978.

ROCK-WATER-GAS INTERACTIONS

36580 (LBL—8648, pp 154-158) **Behavior of rock-fluid systems at elevated pressures and temperatures.** Somerton, W.H.; Ghaffari, A.; Greenwald, R.; Hoang, V.; Martinez-Baez, L.F.; Su, H.J.; Wong, L. 1978.
In Earth Sciences Division. Annual Report 1978.

TIDAL POWER

WAVE ENERGY CONVERTERS

36581 **Apparatus for extracting energy from movement of water .** Cockerell, C. (to Wavepower Ltd UK). US Patent 4,210,821. 1 Jul 1980. Priority date 31 Mar 1976, United Kingdom of Great Britain and Northern Ireland (UK), vpp.

A description is given of an apparatus for converting into useful energy movement imparted thereto by movement of water, comprising at least two interconnected buoyant members each having a substantially continuous surface which contacts the water so that in use of the apparatus said members move relative to each other about the interconnection due to vertical motions of the water, means for converting said relative movements of the interconnected members into useful energy, at least one of said members being provided with a member which in use of the apparatus is movable relative thereto in response to horizontal motions of the water, and means for converting the movement of said member into useful energy, said apparatus in use floating on the surface of the water and being free from any vertical reaction forces between itself and any member supported from the bed of the water, said means responsive to horizontal motions comprising a flap member located for movement within a duct provided in the associated one of said members and movable by water flowing into and out of the duct due to surge motion of the water, said flap member being operatively connected to means for converting its movement into useful energy, said flap being pivotally connected to the associated one of said members, and each duct having a curved wall whose radius is struck from the pivot axis of said flap.

WIND ENERGY

REFER ALSO TO CITATION(S) 36778

36582 (DOE/NASA/23139—1) **Large wind turbines: a utility option for the generation of electricity.** Robbins, W.H.; Thomas, R.L.; Baldwin, D.H. (National Aeronautics and Space Administration,

Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-79ET23139. 19p. (CONF-800424—2; CONF-800865—1). NTIS, PC A02/MF A01.

From American power conference; Chicago, IL, USA (21 Apr 1980).

The wind resource is such that wind energy generation has the potential to save 6 to 7 quads of energy nationally. Thus, the Federal Government is sponsoring and encouraging the development of cost effective and reliable wind turbines. One element of the Federal Wind Energy Programs, Large Horizontal Axis Wind Turbine Development, is managed by the NASA Lewis Research Center for the Department of Energy. There are several ongoing wind system development projects oriented primarily toward utility application within this program element. In addition, a comprehensive technology program supporting the wind turbine development projects is being conducted. This paper presents an overview of the NASA activities with emphasis on application of large wind turbines for generation of electricity by utility systems.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 36600

36583 (AD-A—079831/4) **Torrejon AB, Madrid, Spain. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 3 Oct 1978. 429p. NTIS PC MF A01.

This report is a six-part statistical summary of surface weather observations for Torrejon AB, Madrid Spain. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36584 (AD-A—079837/1) **Upper Heyford Raf, Bicester, United Kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 12 Dec 1978. 403p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Upper Heyford Raf, Bicester, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36585 (AD-A—079838/9) **Ramstein AB, Landstuhl, Germany. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 10 Oct 1978. 410p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Ramstein AB, Landstuhl, Germany. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36586 (AD-A—079839/7) **Spangdahlem AB, Dudeldorf, Germany. revised uniform summary of surface weather observations (russwo). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 19 Jan 1979. 414p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Spangdahlem AB, Dudeldorf Germany. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36587 (AD-A—079840/5) **Clark AFB, Angeles, Philippines. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 22 Feb 1979. 405p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Clark AB, Angeles, Philippines. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36588 (AD-A—079841/3) **Hahn AB, Hunsbruck, Germany. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 29 Sep 1978. 392p. NTIS, PC A17/MF A01.

This report is a six-part statistical summary of surface weather observations for Hahn AB, Hunsruck, Germany. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36589 (AD-A—079842/1) **Dyess AFB, Abilene, Texas. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 16 Nov 1978. 468p. NTIS, PC A20/MF A01.

This report is a six-part statistical summary of surface weather observations for Dyess AFB, Abilene, Texas. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36590 (AD-A—079843/9) **Grand Forks, AFB, Grand Forks, North Dakota. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 13 Oct 1978. 475p. NTIS, PC A20/MF A01.

This report is a six-part statistical summary of surface weather observations for Grand Forks AFB, Grand Forks, North Dakota. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36591 (AD-A—079844/7) **Anderson AFB, Agana, Guam. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 31 Aug 1978. 413p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Anderson AFB, Agana, Guam. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36592 (AD-A—079845/4) **Bitburg AB, Bitburg, Germany. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 20 Feb 1979. 407p. NTIS, PC A18/MF A01.

This report is a six-part statistical summary of surface weather observations for Bitburg AB, Bitburg, Germany. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36593 (AD-A—079846/2) **Carswell AFB, Fort Worth, Texas. revised uniform summary of surface weather observations. (RUSSWO) parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 28 Aug 1978. 458p. NTIS, PC A20/MF A01.

This report is a six-part statistical summary of surface weather observations for Carswell AFB, Fort Worth, Texas. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36594 (AD-A—079847/0) **Grissom AFB, Peru, Indiana. revised uniform summary of surface weather observations (RUSSWO). Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 30 Aug 1978. 453p. NTIS, PC A20/MF A01.

This report is a six-part statistical summary of surface weather observations for GRISSOM AFB, Peru, Indiana. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36595 (AD-A—079848/8) **March AFB, Riverside, California. revised uniform summary of surface weather observations (RUSSWO). Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 28 Nov 1978. 473p. NTIS, PC A20/MF A01.

This report is a six-part statistical summary of surface weather observations for March AFB, Riverside, California. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36596 (AD-A—079849/6) **Minot AFB, Minot, North Dakota. revised uniform summary of surface weather observations (RUSSWO). Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 3 Nov 1978. 479p. NTIS, PC A21/MF A01.

This report is a six-part statistical summary of surface weather observations for Minot AFB, Minot, North Dakota. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables.

36597 (DOE/CS/20160—01) **Site insolation and wind power characteristics, technical report northeast region. Vol. 2.** (Northrop Services, Inc., Huntsville, AL (USA)). Aug 1980. Contract AC01-77ET-20160. 104p. NTIS, PC A06/MF A01.

This phase of the Site Insolation and Wind Power Characteristics Study was performed to provide statistical information on the expected future availability of solar and wind power at various sites in the Northeast Region of the US Historic data (SOLMET), at 8 National Weather Service stations with hourly solar insolation and collateral meteorological information, were interrogated to provide an estimate of future trends. Solar data are global radiation incident on a horizontal surface, and wind data represent wind power normal to the air flow. Selected insolation and wind power conditions were investigated for their occurrence and persistence, for defined periods of time, on a monthly basis. Global horizontal insolation are related to inclined surfaces at each site. Ratios are provided, monthly, for multiplying global insolation to obtain insolation estimates on south-facing surfaces inclined at different angles with respect to the horizontal.

36598 (NP—25005, pp 19p, Paper 11) **Wind energy.** Jagadish, B.S. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Information is presented concerning wind power kinetics; wind power availability in India; and design characteristics of various types of wind turbines.

36599 **Application study of wind power technology to the city of hart, michigan, 1977.** Park, G.L.; Krauss, O.; Asmussen, J. Jr.; Lawler, J. (Mich State Univ, East Lansing). pp vp of Joint power generation conference. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From Joint power generation conference; Charlotte, NC, USA (7 Oct 1979).

This paper reviews the feasibility of wind power application for a small municipal electric system. It analyzes and evaluates the local wind energy resource, wind-turbine sites and hydro-storage as related to the existing electric system. Commercial availability of 500-kW and 1,500-kW wind turbine generators was assumed. Capital and production-cost models yielded bus-bar-cost estimates for wind-generated electricity which are compared with the cost of oil-fueled diesel generation. Development of a simplified production-cost model, to simulate the hourly behavior of small electric systems, was part of the task. Therefore, one important product of the study is a process for evaluating feasibility of wind-energy generation for small utilities. This paper describes the process by means of its application to Hart, Michigan. A supplemental task included in the project was the assessment of the wind-hydroelectric potential combined with hydro-storage in western Michigan as it relates to wind power utilization. 2 refs.

ECONOMICS

REFER ALSO TO CITATION(S) 36600

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 36471

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 36598

36600 (DOE/PE—03871-01, pp 6.1-6.32) **Wind power systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

Information is presented concerning different types of wind turbines; turbine cost and operating economics; power generation; energy storage; and wind power availability in the US.

36601 (SAND—80-0475C) **Torque ripple in a Darrieus, vertical axis wind turbine.** Reuter, R.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 17p. (CONF-801102—3). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Interaction between a steady wind and a rotating, Darrieus, vertical axis wind turbine produces time periodic aerodynamic loads which cause time dependent torque variations, referred to as torque ripple, to occur in the mechanical link between the turbine and the electrical generator. There is concern for the effect of torque ripple upon fatigue life of drive train components and upon power quality. An analytical solution characterizing the phenomenon of torque ripple has been obtained which is based upon a Fourier expansion of the time dependent features of the problem. Numerical results for torque ripple, some experimental data, determination of acceptable levels and methods of controlling it, are presented and discussed.

POWER CONVERSION SYSTEMS

36602 (RFP—3093/94445/3533/80/7) **Study of dispersed small wind systems interconnected with a utility distribution system. Interim report: preliminary hardware assessment.** Curtice, D.; Patton, J.; Bohn, J.; Sechan, N. (Systems Control, Inc., Palo Alto, CA (USA)). Mar 1980. Contract AC04-76DP03533. 114p. NTIS, PC A06/MF A01.

Operating problems for various penetrations of small wind systems connected to the distribution system of a utility are defined. Protection equipment, safety hazards, feeder voltage regulation, line losses, and voltage flicker problems are studied, assuming different small wind systems connected to an existing distribution system. To identify hardware deficiencies, possible solutions provided by off-the-shelf hardware and equipment are assessed. Results of the study indicate that existing techniques are inadequate for detecting isolated operation of a small wind system. Potential safety hazards posed by small wind systems are adequately handled by present work procedures although these procedures require a disconnect device at synchronous generator and self-commutated inverter small wind systems.

SITE CHARACTERISTICS

36603 (DOE/ET/20355—79/4) **Computer model for large arrays of wind turbines.** Justus, C.G.; Mikhail, A.S. (Georgia Inst. of Tech., Atlanta (USA). School of Geophysical Sciences). May 1979. Contract AS06-76ET20355. 46p. (RLD—2439-79/4). NTIS, PC A03/MF A01.

A synthesis of the earlier studies of wind and power distributions for large arrays of wind turbines is formulated in a computer model program. The program can be run with interactive (computer terminal) or batch input (card files, etc.). Based on a generic wind turbine power model, input characteristics at a single representative site, and data specifying the size of the array to be simulated, the program computes wind speed and wind power output statistics for the model array. Wind data for the input single site can be at 10 m level or at hub height (if the former, a height projection to hub height is performed by the program). Time series wind speeds at the single input site can also be used by the program to evaluate equivalent time-series wind speeds and output powers for the array. A program listing and input/output documentation are included.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 37076, 37077

36604 **Operation of the large interconnected power system by decision and control.** Zaborszky, J.; Prasad, K.; Whang, K.W. (Washington Univ, St. Louis, Mo). *IEEE Trans. Power Appar. Syst.;* **PAS-99**: No. 1, 37-45(Jan-Feb 1980).

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 36392

36605 **Heat exchanger apparatus.** Margen, P.; Naslund, R. (to Atomenergi Ab (Sweden)). US Patent 4,210,203. 1 Jul 1980. Priority date 21 Oct 1976, Sweden, vpp.

A description is given of a heat exchanger apparatus comprising a plurality of heat exchanging units each consisting of a sparsely wound, hollow, substantially circular pipe coil, closed at one end, every coil having a substantially identical outside diameter (D) and inside diameter (D), said coil being placed with its open end on a plate provided with a plurality oforifics, said plate screening off a flow passage for a first fluid, and each orifice being substantially axially aligned with a coil, the improvement that said coils are provided on both sides of the plate, that the coils on one side of the plate are arranged with equal centre-to-centre distances (C2) in parallel first rows (R1), that the coils on the other side of the plate are arranged with said centre-to-centre distances (C2) in parallel second rows (R2), that the first rows (R1) and the second rows (R2) are parallel and alternating, that the coils of the first row (R1) are displaced substantially half the said centre-to-centre distance (C2) in the direction of the row relative to those in the second row, and that adjacent opposing coils overlap each other substantially without covering the orifice in the plate of one of the opposing coil S on the other side of the plate, a portion of the first fluid flow ing radially into the interiors of the coils on a first side of the P late and out through the orifices subtantially axially aligned with said coils to a second side of the plate, and another portion of the first fluid flowing into the orifices substantially axially aligned with the coils on the second side of the plate and radially out through the coils on the second side of the plate.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

36606 **Heat exchange system.** Doucette, E.; Shelley, S. (to Doucette Ind Inc). US Patent 4,210,199. 1 Jul 1980. Filed date 14 Jun 1978. vpp.

A description is given of a heat exchange system comprising in combination, (A) a first tube system comprising a plurality of substantially parallel similar tubes, and (B) return members connecting similar ends of adjacent tubes to form a first fluid passage having inlet and outlet means adjacent opposite ends thereof, (C) a second tube system comprising a plurality of similar tubes of larger diameter than the tubes of said first system and respectively surrounding at least portions of the same between opposite ends thereof, and (D) additonal connecting means positioned inwardly from the outer ends of the tubes of said first tube system and connected between similar ends of adjacent tubes of said second tube system for intercommunication therebetween to form a second fluid passage having fluid inlet and outlet means surrounding the tubes of said first tube system; (E) the improvement comprising leak-conducting means substantially coaxial and coextensive with said tubes of said first tube system and comprising supplemental tubular wall means surrounding said tubes of the first system in spaced relationship thereto and having outer ends extending beyond the ends of the tubes of said second tube system, said supplemental tubular wall means having a continuous spiral groove roll formed therein to compress the bottom of said groove into firm thermal contact with said tubes of the first system without substantial decrease of the wall thickness of said supplement

tubular wall means to provide a spiral passage arond the tubes of said first tube system for discharge of leaking fluid to atmosphere at opposite ends of said leak-conducting means to prevent contamination of fluids respectively in said first and second tube systems in the event of leakage openings occurring in any of the tubes on the interior of said second tube system.

POWER CYCLES

REFER ALSO TO CITATION(S) 37082, 37089, 37090

36607 (FE—2357-63) **PFB Coal Fired Combined Cycle Development Program. Quarterly report, October-December 1979.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 1979. Contract AC01-76ET10377. 44p. NTIS, PC A03/MF A01.

During the past quarter, prime attention has been directed toward fulfilling the overall objectives of the 10 x 100 hour test performed in Leatherhead, England. The overall test specimen exposure goal of 1000 hours has been attained. Initial visual examination of the specimens revealed no evidence of erosion for either the cooled specimen (1350°F metal) or uncooled specimen (1475°F metal). The 1000 hour clad/coated airfoil test at Exxon is also complete. Preliminary results indicate CoCrAlY and FeCrAlY suffered the least erosion. Metal temperatures were 1550°F. Cold flow experiments with the Air Shield cyclone model during the past several months have shown that the measured efficiency of this unit is substantially superior to the reported grade efficiency for the (industry standard) Stairmand high-flow cyclone design. This higher efficiency persists even when the dirty flow is injected into what is intended to be the clean air shield adjacent to the exhaust duct. Since the Air Shield cyclone is similar in many respects to the Stairmand high-flow cyclone, its superior performance was initially surprising. Subsequent testing of a revamped Developmental Cyclone (modified to approximate the Stairmand design) confirmed the lower Stairmand performance. The superior dust penetration of the Air Shield model is attributed to: smaller outlet diameter, greater engagement length, and rounded corners at the scroll/body junction. Modifications to the Air Shield cyclone to incorporate a center electrode cage structure were completed. This design allows the application of a high voltage field to augment particle separation over the entire length of the cyclone. Conclusions drawn from these experiments with the Air Shield Cyclone are given.

36608 (ORNL/TM—6252) **Summary of the development of open-cycle gas turbine-steam cycles.** Lackey, M.E.; Thompson, A.S. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 69p. NTIS, PC A04/MF A01.

Combined-cycle plants employing gas turbine cycles superimposed on conventional steam plants are well developed. Nearly 200 units are operating in the US on clean fuels (natural gas or distillate fuel oils) and giving overall thermal efficiencies as high as 42%. Future plants will have to use coal or coal-derived fuels, and this presents problems because gas turbines are very sensitive to particulates and contaminants in the fuel such as sulfur, potassium, lead, etc. If clean liquid or high-Btu gaseous fuels are made from coal, it appears that the conversion efficiency will be no more than 67%. Thus, the overall efficiency of utilization of coal would be less than if it were burned in a conventional steam plant unless the permissible gas turbine inlet temperature can be increased to ~ 1500°C (2732°F). Coupling a combined-cycle power plant directly to a low-Btu coal gasifier increases the fuel conversion efficiency and permits salvaging waste heat from the gasifier for feedwater heating in the steam cycle. By using a gas turbine inlet temperature of 1315°C (2400°F), well above the current maximum of ~ 1040°C (1904°F), an overall efficiency of ~ 40% has been estimated for the integrated plant. However, as discussed in companion reports, it is doubtful that operation with gas turbine inlet temperatures above 1100°C (2012°F) will prove practicable in base-load plants.

36609 **Power generating method and apparatus** . Chih-kang, S. US Patent 4,209,992. 1 Jul 1980. Filed date 4 Nov 1977. vpp.

A description is given of a method of power generation comprising performing a working cycle on a refrigerant used as a working medium and utilizing said refrigerant to drive a turbine operating a power generator, said cycle including the steps of: providing a source of refrigerant in a compressed liquid phase; heating said source by immersion in a tank of relatively hot liquid to provide high pressure vaporized refrigerant; passing said highpressure vaporized refrigerant through the turbine to drive the turbine, passage of the vaporized refrigerant through the turbine reducing the pressure of the vaporized refrigerant; exhausting the reduced pressure vaporized refrigerant from the turbine; cooling the reduced pressure vaporized refrigerant; compressing the cooled vaporized refrigerant in a compressor arrangement having supplies of hot and cold liquid respectively to convert the refrigerant to its liquid phase at a pressure higher than the source pressure; and returning the compressed liquid refrigerant to said source, wherein said supply of cold liquid iis derived from a condensor circuit through which the cold liquid flows in heat transfer relation with liquid used for cooling the reduced pressure refrigerant and said supply ofhot liquid is derived from said tank.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 36320

36610 **Cogeneration at Hilo Coast Processing Company.** Krippene, B.C.; Nolte, F.S.; Iwami, L. Pepeekeo, HI; Hilo Coast Processing Company (1979). 13p. (CONF-7910192—1).

From Industrial fuel conference; West LaFayette, IN, USA (3 Oct 1979).

The Hilo Coast Processing Co. has a sugar mill at Pepeekeo, Hawaii which burns approximately 400,000 tons of bagasse and wood chips annually for the simultaneous generation of process heat and electric power. The application of cogeneration at the Company has been a success. With approximately 85% of the energy coming from a replenishable fuel source which is solar energy derived, i.e., bagasse, HCPC furnishes all of the steam and power needs of its sugar mill yet exports power on a guaranteed basis to meet 23% of the annual electrical power requirements of the big island of Hawaii. Careful attention to detail and continuing up-dating of equipment has resulted in 98.6% availability of the plant for the last 48 week annual operating period. Such high reliability is particularly important for power generation on the island of Hawaii because of its isolation and absence of ties to other utility systems. In this time of energy concern, the installation at Pepeekeo shows what can be done to use replenishable natural resources to their fullest while reducing the dependence on fossil fuels. (LCL)

36611 **Narrative statement for southeast resource recovery facility feasibility study.** Whittier, CA; County Sanitation Districts of Los Angeles County (1978). 56p. (NP—25118).

The feasibility of replacing landfill-type municipal waste disposal practices in the Long Beach, California area with a refuse-to-energy facility which will cogenerate steam and electric power is examined by discussing disposal needs, description of proposed facility, and project success factors. (LCL)

COMPONENTS

36612 (DOE/PE—03871-01, pp 12.1-12.22) **On-site combustion turbine-powered energy systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The technical, economic, environmental, and legal aspects are described of on-site power generating units which consist of gas turbines driving an electric generator and a waste heat recovery boiler that recovers heat from the exhaust gases. Currently about 85 manufacturers produce the power generating units which are used in industrial and commercial building complexes. Units burning natural gas or distillate fuels pose no environmental problems. Current research is concentrating on coal-fueled units. (LCL)

36613 (DOE/PE—03871-01, pp 13.1-13.11) **On-site diesel-powered energy systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The feasibility of installing diesel engines for on-site electric power and heat generation in large residential, commercial or industrial buildings is discussed in terms of total energy requirements, technical aspects, economics, and environmental effects. (LCL)

36614 (EPRI-CS—1512) **Recommended design guidelines or feedwater pumps in large power generating units. Final report.** Makay, E.; Szamody, O. (Energy Research and Consultants Corp., Morrisville, PA (USA)). Sep 1980. 145p. NTIS, PC A07/MF A01.

Guidelines are provided to assist in the specification and procurement of feed water pumps, especially boiler feed pumps for large (over 600 MW) fossil-fuel-fired plant. However, the material is also applicable to circulating pumps for nuclear steam generators and to other feed water pump applications. The purpose is to make available guidance and conclusions based on the best available information on feed water pumps, with emphasis on design and performance requirements necessary to avoid or minimize many frequently-observed problems. Pro-forma language for specification provisions needed to implement this purpose is provided together with related technical discussions of pump problems and their roots in design, manufacture, and operation. Questionnaires are provided to aid the preparation of specifications and the evaluation of vendor proposals. The technical scope includes design and materials, pump characteristics, bearings and critical speeds, seals, axial-balancing devices, and couplings, as well as testing, recirculation requirements, and component life expectancy. The need is stressed for designing pumps for reliable performance, even at the cost of some efficiency at the best efficiency point. It is also essential to design for stable

opeation over a wide range of conditions, as many fossil-fuel plants are likely to be subject to cyclic operation at some future time.

36615 (EPRI-EL—1424(Vol.4)) **Determination of synchronous machine stability study constants. Final report.** Jenkins, K.; Wharmby, B.; Heard, J.S.; Pulle, V.R.; White, B.J. (NEI Parsons Ltd., Newcastle upon Tyne (UK)). Aug 1980. 109p. NTIS, PC A06/MF A01.

The broad objectives of Research Project 997-1 covered: (1) the experimental determination of turbine generator parameters in a manufacturer's works and in power stations; and (2) the development of generator model structures for system stability calculations and their subsequent validation by comparison with system stability tests. The method used to measure parameters over a range of frequencies at standstill on four generators (rated at 200, 250, 500, and 680 MW) in a manufacturer's works and the development of models from those measurements are described. Comparison showed that a model derived from standstill frequency response tests has improved accuracy over a model using design data (Kilgore's theory) in predicting peak values and damping rates for power flow and field current response. The standstill frequency response method has advantages for both manufacturers and utilities, particularly in regard to low cost and short test duration.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 36606, 36621, 36803, 37091, 37092

ECONOMICS

REFER ALSO TO CITATION(S) 36765, 36766, 36767, 36768, 36772

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 36287, 36640, 36774, 37179

36616 (AD-A—079668/0) **Environmental statement, Oswego Steam Station, unit six. Final report.** Leuchner, P.G. (Corps of Engineers, Buffalo, NY (USA). Buffalo District). 29 Mar 1973. 285p. NTIS, PC A13/MF A01.

A detailed analysis of the environmental impacts related to the construction and operation of an oil-fueled electric generating station. The proposed unit will be constructed on a 91 acre tract along the south shore of Lake Ontario in the City of Oswego, Oswego County, New York. There are several steam electric generating units already in operation at this location. Steam produced by the proposed unit will be used to generate approximately 816 megawatts of electrical power. The water intake and effluent discharge system will be located in Lake Ontario. Approximately nine million barrels of fuel oil will be consumed annually.

36617 (AD-A—079676/3) **Environmental statement, Lake City Station, unit one. Final report.** Leuchner, P.G. (Corps of Engineers, Buffalo, NY (USA). Buffalo District). 17 Sep 1973. 309p. NTIS PC MF A01.

A detailed analysis of the environmental impacts related to the construction and operation of an oil-fueled electric generating station. The proposed plant will occupy a 639 acre site on the south shore of Lake Erie in Girard Township, Erie County, Pennsylvania. Electrical power generated by this facility will vary between 245 megawatts and 295 megawatts. The water intake and effluent discharge system will be located in Lake Erie. Approximately 1.4 million barrels of No. 2 fuel oil will be consumed annually.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 35864, 35908, 36607, 37229

36618 (EPRI-CS—1533) **Studies of long-term chemical and physical properties of mixtures of flue gas cleaning wastes. Final report.** Jones, B.F.; Thompson, C.M.; Lamkin, A.G.; Williams, K.R. (Radian Corp., Austin, TX (USA)). Sep 1980. 159p. NTIS, PC A08/MF A01.

Results of a 2 year study of physical and chemical properties of mixtures of flue gas cleaning wastes representing 70 compositions and 10 fly ashes are documented in this report. This study was aimed at developing information needed to provide the utility industry with a more sound basis for selection of disposal methods and viable utilization options for these wastes. FGC waste mixtures having high unconfined compressive strengths after 56 days of curing (above 7 MPa or 1000 psi) will be relatively impermeable. These high strengths will increase with time and will be accompanied by a decrease in permeability and porosity. Low strength FGC waste mixtures (less than 0.7 MPa or 100 psi) will lose strength during long term curing and will become even more permeable and porous. The behavior of mixtures which develop strengths between 0.7 MPa and 7 MPa will depend upon the type of fly ash present. The type of fly ash used in a FGC waste mixture will have a greater influence on leachate quality generated by the waste than the relative amount of fly ash present in the mixture. Leachates from cured FGC wastes have the potential to contaminate groundwater if disposed of improperly. In this study concentrations of arsenic, cadmium, chromium, selenium and silver were found to exceed EPA's primary drinking water standards on a case by case basis. Concentrations of iron, sulfate and pH consistently exceeded EPA's secondary drinking water standards Boron and molybdenum in many cases exceeded recommended limits for irrigation water. However, leachate concentrations by themselves will not determine groundwater contamination. Processes of dilution, dispersion, adsorption and filtration in the soils and liners beneath a waste disposal site could potentially mitigate contamination problems.

36619 **Removal of nitrogen oxides** . Aibe, T.; Itoga, K.; Ninomiya, N.; Nishino, H. (to Takeda Chemical Industries Ltd (Japan)). US Patent 4,210,628. 1 Jul 1980. Priority date 12 Jul 1973, Japan, vpp.

A description is given of a process for treating a waste gas, which consists essentially of the steps of contacting a nitrogen oxide-containing waste gas with activated carbon as the sole catalyst in the presence of gaseous ammonia and oxygen at a temperature between about 150°C. and about 250°. to convert the nitrogen oxide to nitrogen, whereby the nitrogen oxide is removed from said waste gas, said gaseous ammonia being present in amounts not less than 2/3 mole per mole, in terms of NO, of the nitrogen oxide contained in the waste gas and wherein the oxygen is present in an amount of not less than 0.5 mole per mole, in terms of NO, of the nitrogen oxide contained in the waste gas.

36620 **Flue gas treatment** . Michalko, E. (to UOP Inc). US Patent 4,210,629. 1 Jul 1980. Filed date 1 Mar 1979. vpp.

A description is given of a process for the absorptive removal of sulfur dioxide from a gaseous mixture by contacting said gaseous mixture in a scrubbing zone with a scrubbing liquor comprising an aqueous alkaline carbonate reagent solution having dissolved therein an undesirable quantity of silica contaminant which, upon the lowering of the pH of said scrubbing liquor tends to precipitate from solution and form deleterious deposits which interfere with the functioning of said scrubbing zone, the improvement which comprises the prior addition of a water soluble basic salt of aluminum to said scrubbing liquor before the contacting of said liquor with said gaseous mixture thereby effecting a chemical reaction between said silica and said basic salt of aluminum to obtain an aluminosilicate compound having a minimum deleterious effect when precipitated and relatively minor interence with the functioning of said scrubbing zone.

36621 **Air quality impacts of selected emerging energy technologies.** Toussaint, C.R.; Goidell, L.C. (US DOE, Germantown, Md). *Proc. Air Pollut. Control Assoc.*; 1: vp(1979).

The current status of the resolution of air quality issues for each of the eight selected emerging energy technologies are presented. Air quality issues discussed include: pollutant identification and control, transport and effects, and monitoring; identification of future research needs; and impact of applicable air pollution control regulations. 19 refs.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 36254, 36273, 36274, 36275, 36416, 36418, 36420, 36424, 36425, 36426, 36428, 36429, 36430, 36432, 36433, 36434, 36435, 37247

36622 (AD-A—079956/9) **A monitor unit for automatically logging power line disturbances. Technical report.** Kemp, W.M. (Electronics Research Lab., Adelaide (Australia)). Sep 1979. 38p. NTIS, PC A03/MF A01.

A portable monitor system has been developed for automatically gathering data on the quality of electrical mains supplies. The equipment will store the number of times overvoltages or undervoltages occur in a chosen period, and will give a breakdown of the data into five disturbance-duration categories, plus an indication of the accumulated disturbance time. The equipment is self-contained and requires no attention during the monitoring period, making it particularly useful for remote or unmanned sites. Up to 100,000 excursions outside the preset thresholds can be tallied in any one period. The unit will continue to acquire and store data through extended mains failures for virtually the shelf life of its internal battery.

36623 (CONF-800491—, pp 277-280) **Microwave system performance summary.** Arndt, G.D. (Johnson Space Center, Houston, TX); Nalos, E.J. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The SPS microwave system as defined in the October 1978 Reference System Report, DOE/ER-0023, is briefly described. The system will utilize a 1 Km diameter phased array antenna with a 10 dB gaussian taper illumination which focuses the beam at the center of the ground antenna/rectifying system (rectenna). The power beam has approximately 88% of its energy within a 5 Km radius from the rectenna boresight, with a resultant beam width of 1.2 arc-minutes. Mechanical alignment of the 1 Km antenna is maintained within one arc-minute while electronic alignment has a 1.8 arc-second accuracy. The dc-rf power converters within the antenna are 70 KW klystrons fed by 40 KV power lines from a series/parallel solar array configuration. The antenna is divided into 7220 mechanical subarrays, 10.4 meters x 10.4 meters on a side, having slotted waveguides as the radiating surface. Slotted waveguides were selected because of their high power handling capabilities and low I^2R losses. Recent modifications to the reference system are discussed. (WHK)

36624 (CONF-800491—, pp 285-288) **Phase control system concepts and simulations.** Lindsey, W.C. (LinCom Corp., Pasadena, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A summary overview of the Solar Power Satellite (SPS) reference phase control system as defined in a three phase study effort under contract to the Johnson Space Center is given. Key results pertinent to the SPS reference phase control system design are summarized. These results are a consequence of extensive system engineering tradeoffs provided via mathematical modeling, optimization, analysis and the development/utilization of a computer simulation tool called SOLARSIM.

36625 (CONF-800491—, pp 289-292) **Interferometer-based phase control system.** Ott, J.H.; Rice, J.S. (Novar Electronics Corp., Barberton, OH). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

An interferometer-based phase control system for focusing and pointing the SPS power beam is discussed. The system is ground based and closed loop. One receiving antenna is required on earth. A conventional uplink data channel transmits an 8-bit phase error correction back to the SPS for sequential calibration of each power module. Beam pointing resolution is better than 140 meters at the Rectenna.

36626 (CONF-800491—, pp 293-296) **Power satellite sonic simulator.** Ott, J.H.; Rice, J.S. (Novar Electronics Corp., Barberton, OH). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A simulator is described which generates and transmits a beam of audible sound energy mathematically similar to the SPS power beam. The simulator provides a laboratory means for analysis of ground based closed loop SPS phase control and of ionospheric effects on the SPS microwave power beam.

36627 (CONF-800491—, pp 323) **SPS rectenna system.** Andryczyk, R.W. (General Electric Co., Valley Forge, PA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36628 (CONF-800491—, pp 328-331) **Rectenna system design.** Brown, W.C.; Dickinson, R.M.; Nalos, E.J.; Ott, J.H. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The function of the rectenna in the solar power satellite system is to convert the downcoming microwave power beam to electrical grid power. Due to its large physical size (a typical rectenna site is a 10 KM x 14 KM ellipse) and element composition (over 10^9 diode assemblies), the projected cost savings of automatic mass production are of prime importance. The fundamental processes at the rectenna consist of rectifying the incident rf field into dc current using Schottky barrier diodes, filtering the rectified output, combining it and processing it to higher voltages for distribution. Hierarchial combination and processing of currents is done several times to integrate the relatively low power per diode to electrical grid power magnitudes. The basic design choices based on the desired microwave field concentration and ground clearance requirements are outlined. The current design utilizes a non-concentrating inclined planar panel with a 2 meter minimum clearance.

36629 (CONF-800491—, pp 332-335) **Theoretical study of microwave beam absorption by a rectenna.** Ott, J.H.; Rice, J.S.; Thorn, D.C. (Novar Electronics Corp., Barberton, OH). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36630 (CONF-800491—, pp 336-339) **Power amplifiers (tube).** Brown, W.C. (Raytheon Co., Waltham, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The microwave tube devices that have been proposed to meet the SPS transmitter requirements of very high efficiency, low mass, long life, high temperature operation, and low radio frequency interference are the klystron, magnetron, amplitron, and two new devices, the gyrotron and the photoklystron. The klystron and the magnetron in its directional amplifier form are the furthest advanced and have received the most attention. The klystron approach proposes a 70 kilowatt design with depressed collectors and recycled dc power for high efficiency and a heat pipe system to radiate the heat. The magnetron directional amplifier approach proposes an efficient 3 to 5 kilowatt tube scaled from the microwave oven magnetron and an attached radiator made from pyrographite to passively radiate heat.

36631 (CONF-800491—, pp 348-351) **Offshore rectenna feasibility.** Freeman, J.W. (Rice Univ., Houston, TX); Hervey, D.; Glaser, P. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The principal results of a preliminary study of the feasibility and cost of an offshore rectenna to serve the upper metropolitan east coast are outlined. The study proceeded by first locating a candidate site at which to build a 5 GW rectenna. The site was selected on the basis of proximity to load centers, avoidance of shipping lanes, sea floor terrain and conditions, etc. Several types of support structures were selected for study based initially on the reference system rectenna concept of a wire mesh ground screen and dipoles each with its own rectifier and filter circuits. The study also looked at possible secondary uses of an offshore rectenna.

36632 (CONF-800491—, pp 352-355) **High-power microwave optics for flexible power transmission systems.** Drexler, K.E. (M.I.T. Space Systems Lab., Cambridge, MA); Sperber, B.R. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

In the conventional SPS concept, a one kilometer diameter phased array broadcasts directly to a ten kilometer wide rectenna. Diffraction optics, economics, and microwave power density limitations at the transmitter and in the ionosphere set the power of this system at 5 GW, and have restricted consideration of alternative systems to powers within a factor of two of this level. While such a system might prove attractive, a system with far greater flexibility appears feasible. A non-optimized concept is briefly described. A large concave microwave mirror near the transmitter can magnify the apparent size of the Earth as seen from a phased array, and vice versa, permitting a small phased array to be coupled to a small rectenna while preserving the transmission efficiency (the reflection loss is slight) and peak power densities characteristic of the reference system. This augmentation of the phased array aperture with a large mirror gives the system greater resolution (in the optical sense), and opens new degrees of freedom in SPS design. The consequences of such an approach for a prototype satellite are described.

36633 (CONF-800491—, pp 356-358) **SPS power transmission: are multiple beams a better option for Europe.** Henderson, R.A.; Stark, J.P. (British Aerospace Dynamics Group, Bristol, GB). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A multibeam microwave transmission concept is proposed which has minimal impact on present SPS concepts. The rectenna areas are significantly reduced and can be related more closely to user country or community requirements for electrical power needs. Utility grid costs and complexity are reduced; interface requirements being commensurate with present technology.

36634 (CONF-800491—, pp 359-363) **Electric power processing, distribution, management and energy storage.** Giudici, R.J. (Marshall Space Flight Center, Huntsville, AL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Power distribution subsystems are required for three elements of the SPS program: (1) orbiting satellite, (2) ground rectenna, and (3) Electric Orbiting Transfer Vehicle (EOTV). Power distribution subsystems receive electrical power from the energy conversion subsystem and provide the power busses, rotary power transfer devices, switchgear, power processing, energy storage, and power management required to deliver regulated power to the load. The grounding, electromagnetic interference control, high voltage plasma interactions, electric thruster interactions, and spacecraft charging of the SPS and the EOTV are also included as part of the power distribution subsystem design. The satellite power distribution subsystem (PDS) is essential but incurs weight and power loss penalties, representing cost, to the SPS. The design approach must be: (1) to define feasible PDS concepts that can accommodate

unprecedented power and voltage levels, (2) to perform system level trade/optimization studies, (3) to select a PDS that minimizes the SPS penalties, and then (4) to develop the high performance components needed to implement the subsystem. The preliminary SPS concepts developed by Rockwell and Boeing from the standpoints of reducing subsystem requirements and of minimizing SPS penalties are considered. Performance improvements and projections are addressed and technology developments are suggested.

36635 (CONF-800491—, pp 364-367) **High voltage systems (tube-type microwave)/low voltage system (solid-state microwave) power distribution.** Nussberger, A.A. (Rockwell International, Downey, CA.); Woodcock, G.R. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

SPS satellite power distribution systems are described, combining the study activities of Rockwell and Boeing Aerospace Company under contract to NASA. The reference satellite power system (SPS) concept utilizes high-voltage klystrons (~ 40 kV) to convert the on-board satellite power from dc to rf for transmission to the ground receiving station. The solar array generates this required high voltage and the power is delivered to the klystrons through a power distribution subsystem as represented in a simplified block diagram. An array switching of solar cell submodules is used to maintain bus voltage regulation. Individual klystron dc voltage conversion is performed by centralized converters. The on-board data processing system performs the necessary switching of submodules to maintain voltage regulation. Electrical power output from the solar panels is fed via switch gears into feeder buses and then into main distribution buses to the antenna. Power also is distributed to batteries so that critical functions can be provided through solar eclipses.

36636 (CONF-800491—, pp 368-371) **Satellite power system operations.** Pugh, F.L. (IBM Federal Systems Division, Westlake Village, CA); Gordon, A.I. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The power levels considered during the evaluation of the various satellite systems have ranged from 5 to 10 GW. It is apparent that, with this power level, both the satellite and the rectenna must be very large and encompass a large number of complex operational system activities. Major elements of the Satellite Power System (SPS) consist of a power satellite placed in a geosynchronous equatorial orbit, and a dedicated ground receiving station (GRS) located at a selected site within the continental United States. The nominal power output of the SPS is established at 5 gigawatts (5 million kilowatts) although, because of various system constraints or losses, it may actually produce between 4 and 5 gigawatts. A fu .ctional analysis of SPS operations is summarized. (WHK)

36637 (DOE/ET/29197—8) **Fundamentals of interruption in vacuum. Eighth progress report.** Greenwood, A.N.; Childs S.E. (Rensselaer Polytechnic Inst., Troy, NY (USA). Center for Electric Power Engineering). 30 May 1980. Contract AS02-78ET29197. 16p. NTIS, PC A02/MF A01.

In analyzing the behavior of a vacuum arc during interruption , a mathematical model has been set up to describe the events occurring in the interelectrode gap during interruption. The reliability of the results obtained using such a model depends on the accuracy of the initial assumptions made in setting up the model equations. Previous results obtained from the model analysis were compared to experimental data and it was found that there was a discrepancy close to current zero. To improve our model results some of the original model assumptions have been reconsidered in order to make the model more closely represent the physical reality of a vacuum arc.

36638 (DOE/PE—03871-01) **Distributed energy systems: a review of related technologies.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1979. Contract EX-76-C-10-3871. 558p. NTIS, PC A24/MF A01.

Twenty-three papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

36639 (DOE/PE—03871-01, pp 1.1-1.37) **Distributed energy systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The term Distributed Energy Systems (DES) is applied to those energy systems which use local energy sources to meet local energy needs, and can vary from a solar water heater for a house to cogenerating plants for supplying electric power and heat to communities. The social, economic, and technical aspects of DES technologies are reviewed and the outlook for DES development in the US is discussed. (LCL)

36640 BPA 1100 KV transmission system development-environmental studies. Rogers, L.E.; Gilbert, R.O.; Lee, J.M. Jr.; Bracken, T.D. (Battelle, Pac Northwest Lab, Richland, Wash). *IEEE Trans. Power Appar. Syst.;* **PAS-98**: No. 6, 1958-1967(Nov-Dec 1979).

AC SYSTEMS, EHV AND UHV

36641 (EPRI-EL—1518) **Development of 500-kV AC cable employing laminar insulation of other than conventional cellulosic paper. Final report.** Bahder, G.; Eager, G.S. Jr.; Walker, J.J.; Dima, A.F. (General Cable Corp., Union, NJ (USA)). Sep 1980. Contract AC01-76ET29252. 138p. NTIS, PC A07/MF A01.

The results of an investigation to develop a 500 kV ac laminar dielectric power cable and joint having insulation with lower losses than conventional cellulosic paper insulation are presented. Background information is presented on proposed low-loss synthetic and composite synthetic/cellulosic paper insulations. From these studies, fibrous polypropylene paper tape and cellulosic paper-polypropylene film-cellulosic paper composite paper (PPP) were chosen. Extensive testing of hand-wrapped cable models fabricated with each type of tape served to eliminate the fibrous polypropylene paper tape from further consideration. Cable model tests indicate that the PPP tape is satisfactory for insulation in 500 kV ac cable, and that oil impregnants now used in conventional cellulosic paper insulated cables are unsuitable, but that silicone oil with an additive is satisfactory for PPP tapes. Laboratory data indicate that it may be necessary with the PPP tapes to use a significantly lower viscosity impregnating oil which has a greater tendency to drain from pipe-type cables than conventional oil. This may require a modification of the moisture seal. Four final pipe-type cables having a conventional moisture seal were manufactured for possible future field testing. The dielectric loss of the final cables is one-fifth that of conventional cellulosic paper insulated cables. The estimated installed cost per MVA-mile of the PPP insulated cable, neglecting losses, is higher than cellulosic insulated cables impregnated with conventional mineral oil. However, the capacitance of the cable insulated with PPP tape is 25% lower than conventional cable, and therefore, the reactance necessary to compensate for the cable charging current is significantly reduced.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

36642 (CONS—3015-T6) **Superconducting fault current limiter. Sixth quarterly technical progress report, November 8, 1979-February 7, 1980.** (Gould-Brown Boveri, Colmar, PA (USA)). 1980. Contract ET-78-C-01-3015. 155p. NTIS, PC A08/MF A01.

Progress in developing an improved superconducting fault current limiter (SCFCL) is described. A mathematical model of the most promising SCFCL design was used for determining transient characteristics, thermal recovery characteristics, and for evaluating types of shunt resistors. Some experimental work was done on Nb_3Sn film properties. (LCL)

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 36287

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 36095, 36673, 36681, 36684, 36702

36643 (ALO—87) **Analysis of scrams and forced outages at boiling water reactors.** Earle, R.T.; Sullivan, W.P.; Miller, K.R.; Schwegman, W.J. (General Electric Co., San Jose, CA (USA)). Jul 1980. Contract AC04-76DP00789. 87p. (NEDG—25202). NTIS, PC A05/MF A01.

This report documents the results of a study of scrams and forced outages at General Electric Boiling Water Reactors (BWRs) operating in the United States. This study was conducted for S: ndia Laboratories under a Light Water Reactor Safety Program which it manages for the United States Department of Energy. Operating plant data were used to identify the causes of scrams and forced outages. Causes of scrams and forced outages have been summarized as a function of operating plant and plant age and also ranked according to the number of events per year, outage time per year, and outage time per event. From this ranking, identified potential improvement opportunities were evaluated to determine the associated benefits and impact on plant availability.

36644 (CONF-800942—2) **Status of reactor-shielding research in the US.** Maienshein, F.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

While reactor programs change, shielding analysis methods are improved slowly. Version-V of ENDF/B provides improved data and Version-VI will be cost effective in advanced fission reactors are to be developed in the US. Benchmarks for data and methods validation are collected and distributed in the US in two series, one primarily for FBR-related experiments and one for LWR calculational methods. For LWR design, cavity streaming is now handled adequately, if with varying degrees of elegance. Investigations of improved detector response for LWRs rely upon transport methods. The great potential importance of pressure-vessel damage is dreflected in widespread studies to aid in the prediction of neutron fluences in vessels. For LMFBRS, the FFTF should give attenuation results on an operating reactor. For larger power reactors, the advantages of alternate shield materials appear compelling. A few other shielding studies appear to require experimental confirmation if LMFBRs are to be economically competitive. A coherent shielding program for the GCFR is nearing completion. For the fusion-reactor program, methods verification is under way, practical calculations are well advanced for test devices such as the TFTR and FMIT, and consideration is now given to shielding problems of large reactors, as in the ETF study.

36645 (CONF-800942—6) **LWR-PV damage estimate methodology.** Wagschal, J.J.; Maerker, R.E.; Broadhead, B.L. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

A credible estimate of the pressure vessel lifetime due to neutron-induced embrittlement is studied. The first step toward this goal is the accurate prediction of fluence and neutron energy spectrum at the pressure vessel. This, in turn, is obtained from least squares unfolding techniques of dosimetry measurements at a surveillance position, transport calculations, and a translation of information obtained at the surveillance position to the damage position. Including a prototypic neutron field like the ORNL Pool Critical Assembly, in which measurements are performed to serve as benchmarks for the LWR-PV surveillance dosimetry program, involves the use of approximate calculational methods. These approximate methods are supplemented by correction factors also known as calculational bias factors, the proper utilization of which requires estimated uncertainties of these biases as well. The source of a few biases for the PCA and some biases and correlations for the group fluxes at two PCA locations are presented.

36646 (DOE/ET/34215—16) **Fuel Performance Improvement Program. Semiannual progress report, October 1979-March 1980.** (Exxon Nuclear Co., Inc., Richland, WA (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1980. Contract AC02-76ET34215;AC06-76RL01830. 69p. NTIS, PC A04/MF A01.

Progress on the Fuel Performance Improvement Program's fuel design tests and demonstration irradiations for October 1979 through March 1980 is reported. Included are the results of out-of-reactor experiments with Zircaloy cladding using a device that simulates the interaction between fuel and cladding. Also included are reports on the irradiation of the advanced LWR fuel designs in the Halden Boiling Water Reactor and in Consumers Power Company's Big Rock Point Reactor. The establishment of the technical bases and licensing requirements for the advanced fuel concepts are also described.

36647 (HEDL-SA—1779) **Reevaluation of ferritic steel DBTT data used in damage function analysis.** Simons, R.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract AC14-76FF02170. 10p. (CONF-791051—30). NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Data used in damage function analysis of ferritic pressure vessel steels was improved in three areas: 1) errors in the fluences were corrected and all fluences renormalized on a common basis, 2) a physically realistic fluence dependence was used to extrapolate data to the desired property change level, and 3) improved a priori damage models were used to account for the energy dependence of damage. The above improvements eliminated spurious structure in the damage functions and reduced data scatter by up to a factor of two. The displacement cross section gave the best overall correlation of the data; but a more spectrally sensitive model for interstitial clusters correlated the A350 ferritic steel data well.

36648 **Passive containment system .** Kleimola, F. (to Nucledyne Engineering Corp). US Patent 4,210,614. 1 Jul 1980. Filed date 18 May 1977. vpp.

A description is given of energy absorbing and quenching apparatus for use in absorbing thermal energy from a vaporized fluid contained within a chamber of conining struture, said apparatus comprising tank means, cooling liquid contained within said tank means, said cooling liquid being of such a volumetric displacement within said tank means as to result in a selected freeboard space within said tank means, passage means formed in said tank means and effective for communicating between said chamber and a lower disposed portion of said cooling liquid within said tank means, pressure repsonsive vlave means operatively closing said passage means an effective for preventing said cooling liquid to flow from said tank means through said passage means to said chamber during normal conditons and prior to said vaporized fluid attaining a first predetermined pressure within said chamber, said valve means being effective upon said vaporized fluid attaining first predetermined pressure to open commuincation through said passage means as between said cooling liquid and said chamber thereby permitting said vaporized fluid to start to flow through said passage means and into said cooling liquid while maintaining said cooling liquid within said tank means to thereby transfer heat energy from said vaporized fluid to said cooling liquid and to develop steam within said vaporized fluid to said cooling liquid and to develop steam within said freeboard space, and said cooling liquid being effective upon sufficient steam being formed within said freeboard space to flow out of said tank means through said passage means and into said chamber to provide quenching of said vaporized fluid within said chamber.

36649 **Preliminary concepts for detecting diversion of light-water reactor spent fuel.** Sellers, T.A. (Sandia Labs., Albuquerque, NM (USA)). pp 565-577 of Nuclear safeguards technology 1978. Vol. 2. Vienna; International Atomic Energy Agency (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Sandia Laboratories, under the sponsorship of the Department of Energy, Office of Safeguards and Security, has been developing conceptual designs of advanced systems to detect rapidly the diversion of LWR spent fuel. Three detection options have been identified and compared on the basis of timeliness of detection and cost. Option 1 is based upon inspectors visiting each facility on a periodic basis to obtain and review data acquired by surveillance instruments and to verify the inventory. Option 2 is based upon continuous inspector presence, aided by surveillance instruments. Option 3 is based upon the collection of data from surveillance instruments with periodic readout, either at the facility or at a remote site and occasional inspection. Surveillance instruments are included in each option to ensure a sufficiently high probability of detection. An analysis technique with an example logic tree that was used to identify performance requirements is described. A conceptual design has been developed for Option 3 and the essential hardware elements are now being developed.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 36095, 36644, 36645, 36646, 36647, 36649, 36673, 36680, 36681, 36682, 36683, 36684, 36685, 36686, 36691, 36693, 36694, 36695, 36696, 36697, 36698, 36699, 36700, 36701, 36702

36650 (DLCS—5000280) **[Shippingport Atomic Power Station]. Quarterly operating report, second quarter 1980.** (Duquesne Light Co., Shippingport, PA (USA)). 1980. Contract AC11-76PN00292. 26p. NTIS, PC A03/MF A01.

At the beginning of the second quarter of 1980, the Shippingport Atomic Power Station remained shutdown for the normally planned semiannual maintenance and testing program, initiated February 29, 1980. The station was in a cooldown condition at approximately 150°F and 300 psig with a steam bubble maintained in the pressurizer and the reactor coolant pumps in slow speed. The station remained in a cooled down condition until April 8, when a plant heat-up was initiated and completed on April 11, from which time normal operating parameters were maintained. The reactor was operated at low power levels as required for cold and hot plannd testing. Base mode operations began on April 19. Swingload operations began May 20 and occurred daily through May 29 with levels ranging down to 30% to 60% power. On May 30, the station underwent a planned shutdown to perform test procedure LWBR-DLCS 64601, Bank Reactivity Worth and Temperature and Power Coefficients of Reactivity at Power. On May 31, criticality was achieved and the station returned to full power. Swingload operations resumed on June 1 and continued daily through the end of the quarter with the exceptions of June 17 and June 30. Swingload levels ranged down to 27.5% to 60% power.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 36668

36651 (GA-A—15799) **High-pressure test loop design and application.** Burnette, R.D.; Graves, J.N.; Blair, P.G.; Baldwin, N.L. (General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AT03-76ET35300. 23p. NTIS, PC A02/MF A01.

A high-pressure test loop (HPTL) has been constructed for the purpose of performing a number of chemistry experiments at simulated HTGR conditions of temperature, pressure, flow, and impurity content. The HPTL can be used to develop, modify, and verify computer codes for a variety of chemical processes involving gas phase transport in the reactor. Processes such as graphite oxidation, fission product transport, fuel reactions, purification systems, and dust entrainment can be studied at high pressure, which would largely eliminate difficulties in correlating existing laboratory data and reactor conditions.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 36057, 36185, 36644, 36650, 36688, 36689, 36690, 36692, 36703, 36914

36652 (DOE-tr—122) **Theoretical and experimental investigation of the nonlinear structural dynamics of fast breeder fuel elements.** Liebe, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). [nd]. Translation of KFK—2584, April 1978. 146p. NTIS (US Sales Only), PC A07/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

This study describes theoretical and experimental investigations of the dynamic deformation behavior of single and clustered fuel elements under local fault conditions in a Fast Breeder Reactor core. In particular an energetic molten-fuel-coolant-interaction (FCI) is assumed in one subassembly with corresponding pressure pulses, which may rupture the wrapper and load the adjacent fuel elements impulsively. Associated coherent structural deformation may exceed tolerable limits and damage the control rods.

36653 (CONF-800804—22) **Applications of one-dimensional models in simplified inelastic analyses.** Kamal, S.A.; Chern, J.M.; Pai, D.H. (Foster Wheeler Corp., Livingston, NJ (USA)). 1980. Contract W-7405-ENG-26. 39p. NTIS, PC A03/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

This paper presents an approximate inelastic analysis based on geometric simplification with emphasis on its applicability, modeling, and the method of defining the loading conditions. Two problems are investigated: a one-dimensional axisymmetric model of generalized plane strain thick-walled cylinder is applied to the primary sodium inlet nozzle of the Clinch River Breeder Reactor Intermediate Heat Exchanger (CRBRP-IHX), and a finite cylindrical shell is used to simulate the branch shell forging (Y) junction. The results are then compared with the available detailed inelastic analyses under cyclic loading conditions in terms of creep and fatigue damages and inelastic ratchetting strains per the ASME Code Case N-47 requirements. In both problems, the one-dimensional simulation is able to trace the detailed stress-strain response. The quantitative comparison is good for the nozzle, but less satisfactory for the Y junction. Refinements are suggested to further improve the simulation.

36654 (EGG-PR—5039) **Gas cooled fast breeder reactor conceptual design for a circulator test facility (modified EOCR facility at the INEL).** (EG and G Idaho, Inc., Idaho Falls (USA); General Atomic Co., San Diego, CA (USA); Parsons (Ralph M.) Co., Pasadena, CA (USA)). Oct 1979. Contract AC07-76ID01570. 217p. NTIS, PC A10/MF A01.

A GCFR helium circulator test facility sized for full design conditions is proposed. The circulator will be mounted in a large vessel containing high pressure helium, permitting testing at the same power, speed, pressure, temperature and flow conditions intended in the demonstration plant. The electric drive motor for the circulator will obtain its power from an electric supply and distribution system in which electric power will be taken from a local utility. A realistic estimate of total project cost is presented, together with a schedule for design, procurement, construction, and inspection. The total estimated cost of this facility escalated to the period of spending, including Title I, II, and III engineering, site work, building modification, special facilities, utilities, standard equipment, and contingency is $21,563,000. Expense-funded operating and capital equipment costs are also presented.

36655 (GA-A—15857) **GCFR development status report.** (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 102p. NTIS, PC A06/MF A01.

This report describes the major design features of the gas-cooled fast breeder reactor being developed in the United States principally at General Atomic Company. The report gives the general design strategy and highlights the design features of the reactor core and the nuclear steam supply components. It describes the design results on plant safety and licensing.

36656 (GA-A—15895) **GCFR core cladding temperature limits.** Day, J.M.; LaBar, M.P. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 22p. (CONF-800648—15). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper reviews the phenomena that affect selection of the GCFR cladding faulted temperature limit. The limiting effects are determined to be clad melting, strength and oxidation rate. The selected temperature limit is 1300°C (2370°F). The limits for normal, upset and emergency events are also breifly reviewed, and some changes under consideration are discussed.

36657 (GA-A—15904) **Design configuration of GCFR core assemblies.** LaBar, M.P.; Lee, G.E.; Meyer, R.J. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 34p. (CONF-800648—11). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

The current design configurations of the core assemblies for the gas-cooled fast reactor (GCFR) demonstration plant reactor core conceptual design are described. Primary emphasis is placed upon the design innovations that have been incorporated in the design of the core assemblies since the establishment of the initial design of an upflow GCFR core. A major feature of the design configurations is that they are prototypical of core assemblies for use in commercial plants; a larger number of the same assemblies would be used in a commercial plant.

36658 (GA-A—15914) **Interim results of the F-5 irradiation experiment and proposed fission product transport mechanisms.** Bell, W.E.; Greenberg, S.; Goodin, D.T.; Langer, S. (General Atomic Co., San Diego, CA (USA); Argonne National Lab., IL (USA)). May 1980. Contract AT03-76SF71023. 26p. (CONF-800648—9). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper presents: (1) results of a study of gamma-scan data for eight fuel rods removed at the end of the first phase of the GCFR F-5 (X317) irradiation experiment in EBR-II; (2) a comparison of cesium and iodine migration behavior in F-5 and previous GCFR irradiation experiments (GB-9, GB-10, and F-1); and (3) proposed cesium and iodine transport mechanisms, based primarily on observed fission product behavior in the irradiation experiments. Two modes of cesium transport, metal vapor transport and xenon precursor transport, are shown to be important. The formation of cesium uranate at the fuel-blanket interface and the effect of uranate formation on cesium transport to the fuel rod trap are discussed. It is shown how cesium isotope concentrations in the fuel rod trap differ for sealed and vented rods.

36659 (GA-A—15915) **Oxidation of 316 stainless steel and other alloys in prototypic GCFR environments.** Acharya, R.T. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 13p. (CONF-800648—17). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

The oxidation behavior of type 316 stainless steel and candidate advanced alloys for the gas-cooled fast reactor (GCFR) is being investigated at General Atomic Company. The test program consists of oxidation tests in prototypic GCFR environments. Two tests have been completed to date and a third test is under way. The first test was performed in an environment containing a hydrogen/water ratio of 10. The oxidation behavior of all the alloys was good to excellent in this environment. Preferential oxidation of chromium was responsible for this behavior. The second test was performed in an environment containing a hydrogen/water ratio of 0.25, where both chromium and iron oxides are thermodynamically stable. Some of the alloys and some of the ribbed type 316 stainless steel test specimens showed unacceptable oxidation resistance in this environment. In the third test, presently under way, two different pretreatment procedures are being used to control the poor oxidation behavior observed in the second test. Early results show some degree of success.

36660 (GA-A—15916) **End of life fission product distributions in F-1 experiment fuel rods.** Goodin, D.T.; Langer, S.; Bell, W.E. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 20p. (CONF-800648—13). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

Fission product migration and end-of-life distributions were examined in the F-1 (X094) series of sealed, mixed-oxide fuel rods irradiated in the fast flux of EBR-II. Cesium, rubidium, iodine, and strontium data obtained from axial gamma scanning, mass spectrometry, and radiochemical analyses are presented. The results show

significant migration of cesium, probably as both a volatile species and as the noble gas precursor. Cesium metal species leaving the fuel region accumulate predominately at the fuel-blanket interface. Volatile cesium reaching the fission product traps is readily sorbed by the charcoal.

36661 (GA-A—15921) **Design and analysis of PCRV core cavity closure.** Lee, T.T.; Schwartz, A.A.; Koopman, D.C.A. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 21p. (CONF-800648—7). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

Design requirements and considerations for a core cavity closure which led to the choice of a concrete closure with a toggle hold-down as the design for the Gas-Cooled Fast Breeder Reactor (GCFR) plant are discussed. A procedure for preliminary stress analysis of the closure by means of a three-dimensional finite element method is described. A limited parametric study using this procedure indicates the adequacy of the present closure design and the significance of radial compression developed as a result of inclined support reaction.

36662 (GA-A—15925) **Thermal conditions and functional requirements for molten fuel containment.** Kang, C.S.; Torri, A. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 25p. (CONF-800648—8). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper discusses the configuration and functional requirements for the molten fuel containment system (MFCS) in the GCFR demonstration plant design. Meltdown conditions following a loss of shutdown cooling (LOSC) accident were studied to define the core debris volume for a realistic meltdown case. Materials and thicknesses of the molten fuel container were defined. Stainless steel was chosen as the sacrificial material and magnesium oxide was chosen as the crucible material. Thermal conditions for an expected quasi-steady state were analyzed. Highlights of the functional requirements which directly affect the MFCS design are discussed.

36663 (HEDL-SA—2100-FP) **Time series analysis of reactor thermocouple data.** Devary, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 10 Apr 1980. Contract AC14-76FF02170. 22p. (CONF-800820—10). NTIS, PC A02/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

Time-series analysis techniques are applied to nuclear reactor thermocouple data to investigate coolant temperatures measured within the fueled test assembly. The coolant temperature distribution within a fuel assembly affects the length of time a fuel assembly may be operated in a power reactor and, therefore, is an important economic consideration in the design of reactor fuel systems. Frequency-domain signal conditioning techniques were used to reveal the smoothly varying thermocouple signals from the noisy digital data. Examination of the cross-correlation function for thermocouple pairs suggested an alternate surging and ebbing of coolant flow within certain zones of the fuel assembly. These zones corresponded to thermocouples which experienced higher or lower than predicted coolant temperatures. This time series analysis contributed greatly toward the understanding of fuel assembly thermal hydraulics.

REGULATION AND LICENSING

36664 (CONF-800942—3) **Radiation protection and shielding standards for the 1980s.** Trubey, D.K.; . (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

The American Nuclear Society (ANS) is a standards-writing organization member of the American National Standards Institute (ANSI). The ANS Standards Committee has a subcommittee denoted ANS-6, Radiation Protection and Shielding, whose charge is to develop standards for radiation protection and shield design, to provide shielding information to other standards-writing groups, and to develop standard reference shielding data and test problems. This paper is a progress report of this subcommittee. Significant progress has been made since the last comprehensive report to the Society.

ECONOMICS

REFER ALSO TO CITATION(S) 36736

36665 (EMD—79-52) **Nuclear power costs and subsidies.** (General Accounting Office, Washington, DC (USA)). 13 Jun 1979. 34p. General Accounting Office, Washington, DC.

Report by the Comptroller General of the United States.

On October 23, 1978, Senator John Melcher asked GAO to identify, to the extent possible, the full cost of nuclear power. Such a cost mainly includes not only industry's costs, but also those borne by the Federal Government to promote or regulated tthe nuclear power industry. GAO found that the average commercial cost of electricity generated by nuclear power plants in the United States during 1978 was reporte to be about 1.5 cents per kilowatt-hour, about the same as it was in 1977. Major Federal nuclear-related costs and subsidies for research and development, uranium enrichment, uranium exploration, and regulation totaled about $1.7 billion during fiscal year 1978, an increase of about $274 million from fiscal year 1977. These costs, based on assumptions described in the report, were equal to 0.62 cents per kilowatt-hour during fiscal year 1978, and 0.57 cents during fiscal year 1977.

FUEL CYCLE

REFER ALSO TO CITATION(S) 36057, 36084

36666 (CONF-800943—6) **Back-end costs of alternative nuclear fuel cycles.** Rainey, R.H.; Burch, W.D.; Haire, M.J.; Unger, W.E. (Oak Ridge Associated Universities, Inc., TN (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

As part of its charter, the Alternate Fuel Cycle Evaluation Program (AFCEP) was directed to evaluate the back-end of the nuclear fuel cycle in support of the Nonproliferation Alternative Systems Assessment Program (NASAP). The principal conclusion from this study is that the costs for recycling a broad range of reactor fuels will not have a large impact on total fuel cycle costs. For the once-through fuel cycle, the costs of fresh fuel fabrication, irradiated fuel storage, and associated transportation is about 1.2 to 1.3 mills/kWh. For the recycle of uranium and plutonium into thermal reactors, the back-cycle costs (i.e., the costs of irradiated fuel storage, transportation, reprocessing, refabrication, and waste disposal) will be from 3 to 3.5 mills/kWh. The costs for the recycle of uranium and plutonium into fast breeder reactors will be from 4.5 to 5 mills/kWh. Using a radioactive spikant or a denatured ^{233}U-Th cycle will increase power costs for both recycle cases by about 1 mill/kWh. None of these costs substantially influence the total cost of nuclear power, which is in the range of 4 cents/kWh. The fuel cycle costs used in this study do not include costs incurred prior to fuel fabrication; that is, the cost of the uranium or thorium, the costs for enrichment, or credit for fissile materials in the discharged fuel, which is not recycled with the system.

36667 (CONF-800943—(Summ.), pp 155-158) **Back-end fuel cycle costs for alternative fuels.** Rainey, R.H.(Oak Ridge Assoc. Univ., TN); Burch, W.D.; Haire, M.J.; Unger, W.E. 1980.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

PROCESS HEAT REACTORS

36668 (CONF-800806—34) **High-temperature gas-cooled reactors and process heat.** Kasten, P.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

High-Temperature Gas-Cooled Reactors (HTGRs) are fueled with ceramic-coated microspheres of uranium and thorium oxides/carbides embedded in graphite blocks which are cooled with helium. Promising areas of HTGR application are in cogeneration, energy transport using Heat Transfer Salt, recovery of oils from oil shale, steam reforming of methane for chemical production, coal gasification, and in energy transfer using chemical heat jpipes in the long term. Further, HTGRs could be used as the energy source for hydrogen production through thermochemical water splitting in the long term. The potential market for Process Heat HTGRs is 100-200 large units by about the year 2020.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

36669 (AD-A—079587/2) **Integral equation space-energy flux synthesis for spherical systems. Final report.** Skluzacek, E.W. (Air Force Technical Applications Center, Patrick AFB, FL (USA)). 21 Nov 1979. 77p. NTIS, PC A05/MF A01.

The calculations of neutron flux distribution and growth rate for small, spherically symmetric systems usually requires extensive computing time on the largest machines. To minimize computing time, a compromise between the simplicity of diffusion theory and the accuracy of transport theory is needed. The Serber-Wilson method, Feynman's method, and early flux synthesis methods are used as the foundation for integral equation synthesis (IES) which is an approximate, numerical technique for obtaining the spatial and energy neutron flux distributions in multiplying systems. In IES, the integral form of the neutron transport equation is specialized to spatial dependence only, and then solved numerically for the two lowest order eigenfunctions. Similar specialization to energy dependence only yields a second set of trial eigenfunctions. Using standard perturbation methods, the two sets of trial eigenfunctions are synthesized into a single, two-dimensional solution. The IES technique was used to calculate the flux and multiplication factor, K, of the critical plutonium sphere, Jezebel. Results for k agreed to within 0.01% of published values, whereas the spatial flux, when normalized at the center, agreed to within 8% at the outer assembly boundary.

36670 (BNL—28048) **Improved numerical techniques for processing Monte Carlo thermal scattering data.** Schmidt, E.; Rose, P. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 5p. (CONF-801107—11). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

As part of a Thermal Benchmark Validation Program sponsored by the Electric Power Research Institute (EPRI), the National Nuclear Data Center has been calculating thermal reactor lattices using the SAM-F Monte Carlo Computer Code. As part of this program a significant improvement has been made in the adequacy of the numerical procedures used to process the thermal differential scattering cross sections for hydrogen bound in H_2O.

36671 (CONF-800942—5) **Solving the uncommon reactor core neutronics problems.** Vondy, D.R.; Fowler, T.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

The common reactor core neutronics problems have fundamental neutron space, energy spectrum solutions. Typically the most positive eigenvalue is associated with an all-positive flux for the pseudo-steady-state condition (k/sub eff/), or the critical state is to be effected by selective adjustment of some variable such as the fuel concentration. With sophistication in reactor analysis has come the demand for solutions of other, uncommon neutronics problems. Importance functionss are needed for sensitivity and uncertainty analyses, as for ratios of intergral reaction rates such as the fuel conversion (breeding) ratio. The dominant higher harmonic solution is needed in stability analysis. Typically the desired neutronics solution must contain negative values to qualify as a higher harmonic or to satisfy a fixed source containing negative values. Both regular and adjoint solutions are of interest as are special integrals of the solutions to support analysis.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 36938

36672 **NDE: in-depth search for flaws.** *EPRI J.;* **5**: No. 6, 16-20(Jul 1980).

The nondestructive evaluation (NDE) process uses ultrasonic, x-ray, eddy-current, and other diagnostic tools to detect internal flaws of components which need repair or replacement. This reduces power plant outages and downtime and is a safety requirement at nuclear power plants. The growing need for better techniques and more highly-trained technicians to improve inspection quality is partially met by recent advances in microprocessor technology and the improved accuracy of fracture mechanics analyses. The Electric Power Research Institute is participating in projects to provide automatic interpretation of ultrasonic and eddy-current test data by exploring a microprocessor-based technique, a signal-processing device, lightweight x-ray sources, and a diode-array imaging camera. A center is under construction for equipment development and personnel training. (DCK)

CONTROL SYSTEMS

36673 (SAND—80-1837C) **Human factors in nuclear power plant operations.** Swain, A.D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 57p. (CONF-801054—1). NTIS, PC A04/MF A01.

From Institute for Reactor Safety meeting; Munich, F.R. Germany (31 Oct 1980).

This report describes some of the human factors problems in nuclear power plants and the technology that can be employed to reduce those problems. Many of the changes to improve the human factors in existing plants are inexpensive, and the expected gain in human reliability is substantial. The human factors technology is well-established and there are practitioners in most countries that have nuclear power plants.

ENVIRONMENTAL ASPECTS

36674 **Environmental impacts of nuclear power in the U.S. to the Year 2000.** Gustafson, P.F. (Argonne National Lab., Ill). pp 544-548 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Current LWR nuclear-generating capacity in the U.S. is about 50 GWe. Projections for on-line capacity in the year-2000 range from a low of 150 GWe to a high of 380 GWe. The most-probable figure is of the order of 200-225 GWe. The primary environmental impacts due to nuclear power plants derive from land use, thermal discharges, and transmission-line corridors. The cumulative impacts due to these factors resulting from the two-fold range in nuclear power production by the year 2000 is discussed. The possible reduction of environmental effects achieved by siting added nuclear capacity at existing sites is discussed.

36675 **Impacts of thermal effluents from nuclear reactors on southeastern ecosystems.** Sharitz, R.R.; Gibbons, J.W. (Savannah River Ecology Lab., Aiken, SC). pp 609-616 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The Department of Energy's Savannah River Plant (SRP) near Aiken, South Carolina provides a unique situation for research into the environmental effects and phenomena associated with the release of high temperature effluents from nuclear production reactors. Reservoirs and streams with surface temperatures above 60°C, moderately warmed swamps and lakes, and other aquatic areas that have received hot water continually for 25 years occur on the site. This paper summarizes some of the studies in thermal ecology conducted on the SRP which have revealed both detrimental and beneficial effects to the environment. 31 refs.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 36697

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 36679, 36687, 36949

36676 (HEDL-SA—2198) **Dual gaging 2200°C Johnson Noise Power Thermometer.** Cannon, C.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1980. Contract AC14-76FF02170. 17p. NTIS, PC A02/MF A01.

A Johnson Noise Power Thermometer (JNPT) for temperature measurements to 2200°C in reactor fuel rods has been fabricated and is being test evaluated for use in the Loss-of-Fluid-Test (LOFT) reactor safety tests. Temperature is determined by measuring the thermal noise spontaneously generated in a sensor coil. Thermoelement wires are used for connecting leads to the sensor coil and thereby provide for simultaneous temperature measurement as a thermocouple. Evaluation units have been fabricated from 1/16-inch diameter Re/W sheath material and HfO_2 insulators using a 0.010-inch diameter Re sensor coil and Re/W thermoelement wires. The thermocouple probe is sealed with an alumina ceramic-to-metal seal and a stainless steel sheathed compensating lead cable transmits the output signal to the measurement instrumentation.

36677 (UCRL—15265) **Inspection methods for physical protection. Task II. Review of research reactor licensees' physical security practices.** (Teknekron Research, Inc., McLean, VA (USA)). 3 Jul 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

Security systems and security procedures for the AFRRI reactor, the University of Maryland TRIGA reactor, and the University of Virginia CAVALIER and UVAR reactors are described.

36678 Health Physics Research Reactor spectrum measurements with threshold detector units. Sims, C.S.; Dickson, H.W. (Oak Ridge National Lab., TN (USA)). *Health Phys.;* **38**: No. 1, 76-78(Jan 1980).

REACTOR SAFETY

REFER ALSO TO CITATION(S) 36672

36679 Plans and progress in decommissioning a research reactor. Voigt, A.F.; Link, B.W.; Struss, R.G.; Hull, D.L.; Voss, M.D. (Ames Lab., IA (USA)). pp 237-247 of Decommissioning of nuclear facilities. Proceedings of an international symposium jointly organized by the IAEA and the OECD NEA and held in Vienna, 13-17 November 1978. Vienna; IAEA (1979).

From International symposium on the decommissioning of nuclear facilities; Vienna, Austria (13 Nov 1978).

The Ames Laboratory Research Reactor (ALRR), a 5 MW heavy water reactor, was built for the Ames Laboratory by the USAEC from 1961 to 1965. It was operated from 1965 to 1977 for a total of 15,200 MW.d and was closed down at the end of 1977. It is at present being dismantled. Plans include removal of the entire reactor structure and all related radioactivity, but retaining the reactor building intact for future Laboratory use. To date the following have been accomplished: removal and shipment of spent fuel and used D_2O; sectioning of reactor plugs, liners, thimbles and control rods according to radioactivity, appropriate packaging and shipping for burial; transfer of experiments to other reactors or to storage; removal of non-essential control room electronics; removal of cooling tower. The dismantling sequence to be followed includes: removal and disposal of remaining plugs, etc., of top plug and appendant assemblies and core tank; sectioning, removal and disposal of six 2.5 cm stainless steel thermal shield plates; breakup, removal and disposal of concrete biological shield and thermal shield tank; removal of auxiliary systems such as exhaust ventilation and stack, not all; preparation of building for future use. The time projected for this task was three years, January 1978 through December 1980, and the projected cost was US 4.5 million. At this time the task is somewhat ahead of schedule and approximately 20% underspent.

36680 (AGNS—35900-1.5-79) **Scoping studies of the alternative options for defueling, packaging, shipping, and disposing of the TMI-2 spent fuel core.** (Allied-General Nuclear Services, Barnwell, SC (USA)). Sep 1980. Contract AC09-78ET35900. 217p. NTIS, PC A10/MF A01.

A portion of this fuel will be shipped to nuclear facilities to perform detailed physical examinations. Removal of this fuel from the TMI-2 core is also a significant step in the eventual cleanup of this facility. The report presents a scoping study of the technical operations required for defueling and canning. The TMI fuel when canned could be stored in the spent fuel storage pool. After a period of on-site storage, it is expected that the bulk of the fuel will be shipped off-site for either storage or reprocessing. Evaluation is made of the technical, economic, and institutional factors associated with alternate approaches to disposition of this fuel. Recommendations are presented concerning future generic development tasks needed for the defueling, packaging, on-site shipping of this fuel.

36681 (CONF-800802—9(Draft)) **Routine and post-accident sampling in nuclear reactors.** Armento, W.J.; Kitts, F.G.; German, G.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Review of the Three Mile Island accident by NRC has resulted in new post-accident-sampling-capability requirements for utilities that operate pressurized water reactors and/or boiling water reactors. Several vendors are offering equipment that they hope will suffice to met both the new NRC regulations and an operational deadline of January 1, 1981. The advantages and disadvantages of these systems and projected future-new-system needs for TVA reactors are being evaluated in light of TMI experience.

36682 (CONF-801002—4) **Importance of thermal nonequilibrium considerations for the simulation of nuclear reactor LOCA transients.** Fischer, S.R.; Nelson, R.A.; Sullivan, L.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 4p. NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The purpose of this paper is to show the importance of considering thermal nonequilibrium effects in computer simulations of the refill and reflood portions of pressurized water reactor (PWR) loss-of-coolnat accident (LOCA) transients. Although RELAP4 assumes thermodynamic equilibrium between phases, models that account for the nonequilibrium phenomena associated with the mixing of subcooled emergency cooling water with steam and the superheating of vapor in the presence of liquid droplets have recently been incorporated into the code. Code calculated results, both with and without these new models, have been compared with experimental test data to assess the importance of including thermal nonequilibrium phenomena in computer code simulations.

36683 (CONF-801002—7) **SUPERH-SG, a computer model describing nonequilibrium, two phase flow in a light water reactor steam generator during reflood.** Wilson, G.E.; Ogden, D.M.; McCreery, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 17p. NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An existing computer model for emergency core cooling reflood heat transfer has been modified to describe the nonequilibrium, two-phase, thermal-hydraulic pheonomena in a double-pass steam generator of a light water reactor during reflood. The predictive quality of the model has been assessed by comparison of calculated results with temperature, quality, and heat transfer data from an experiment which simulated the thermal-hydraulic performance of a pressurized water reactor steam generator. The calculated temperatures and qualities are generally within the experimental data uncertainty for a wide range of test conditions. Calculated heat transfer is less well calculated, but adequate for many purposes.

36684 (CONF-801002—10) **RELAPS choked flow model and application to a large scale flow test.** Ransom, V.H.; Trapp, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 21p. NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The RELAP5 code was used to simulate a large scale choked flow test. The fluid system used in the test was modeled in RELAP5 using a uniform, but coarse, nodalization. The choked mass discharge rate was calculated using the RELAP5 choked flow model. The calulations were in good agreement with the test data, and the flow was calculated to be near thermal equilibrium.

36685 (CONF-801002—11) **Calculated thermal-hydraulic response for Semiscale Mod-3 Test S-07-6 using RELAP5: a new LWR system analysis code.** Kuo, H.H.; Ransom, V.H.; Snider, D.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 17p. NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The newly developed, advanced, light water reactor (LWR) simulation code, RELAP5, is used to analyze the response of Semiscale Mod-3 Test S-07-6. The objective of Test S-07-6 was to provide reference data to evaluate LWR integral blowdown, refill, and reflood behavior during a 200% cold leg break with emergency core coolant (ECC) injected into the intact loop cold leg. The calculated test results using RELAP5 illustrate many of the nonequilibrium and nonhomogeneous aspects of the ECC injection which are not directly observable in the test data. These results also demonstrate the capability of the RELAP5 code and compare well with the test data fo break flow, pressure, temperature, and density throughout the Semiscale Mod-3 system. The periodic depletion and replenishment of ECC water in the downcomer shown in the test data is also shown in the calculation.

36686 (CONF-801102—10) **Critical flow in small nozzles for saturated and subcooled water at high pressure.** Lin, J.C.; Gruen, G.E.; Quapp, W.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 30p. NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Critical flow rate measurements of 4 mm and 16 mm nozzles have been performed with saturated and subcooled water at high pressure. The steady state and transient critical flow tests were conducted by discharging the fluid from a pressurized vessel through a blowdown leg. The fluid stagnation conditions upstream of the nozzle were measured by a gamma densitometer, thermocouple, and pressure transducer. The pressure and temperature of the tests range from 4.5 MPa to 15.0 MPa and from 530 K to 560 K, respectively. The results show that the flow upstream of the nozzle is stratified. The discharge mass flux obtained by this experiment is in good agreement with General Electric (GE) critical flow test data and Henry-Fauske and Burnell critical flow model predictions using a multiplier of 1.0 +- 0.3.

36687 (CONF-801107—20) **Detection, diagnosis, and treatment of accident conditions using response trees.** Nelson, W.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Response Trees were developed at the LOFT facility in 1978 and included in the Plant Operating Manual (POM) to assist reactor operators in selecting emergency procedures. In an emergency situation the operator would manually gather data and evaluate the trees to select the appropriate procedures. As a portion of the LOFT Augmented Operator Capability (AOC) Program, the response tree methodology has been extended so that a computer can be used to evaluate the trees and recommend an appropriate response for an accident. Techniques for diagnosing failures within a cooling mode have also been investigated. This paper summarizes these additions to the response tree methodology.

36688 (DOE/ET/37205—T2) **Chemical simulation modeling of heat transfer in LMFBRs.** Wiberg, D.V. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). Apr 1980. Contract AS02-76ET37205. 123p. NTIS, PC A06/MF A01.

Thesis.

A chemical reaction conducted in a wax cylinder was used in this study to simulate a CDA occurring in a reactor. The exothermic reaction of dimethyl sulfoxide (DMSO) with acetyl chloride (AC) was used as the chemical reaction to simulate the internally heated liquid pool. SUN-3420 wax was used to construct the cylindrical reaction vessel to simulate cladding and containment. During a CDA, a question remains as to whether the containment would be miscible in the molten fuel. To allow for the possibility that either may be true, two cases were evaluated in this study. By using acetone as the solvent in the DMSO and AC solutions, the case in which the vessel was relatively insoluble in the reaction mixture was simulated. By using benzene as the solvent in the DMSO and AC solution, the case in which the molten vessel was more soluble in the reaction mixture was simulated. Based on the findings of this work the proposed heat transfer correlations for volumetrically heated liquid pools may be used with greater confidence as to their accuracy and applicability.

36689 (GA-A—15912) **Inherent design features of the GCFR.** Medwid, W.; Breher, W.; Shenoy, A.; Elliott, R. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 29p. (CONF-800648—14). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper discusses several inherent design features of the GCFR that enhance its safety and presents analyses to demonstrate the degree of protection they provide. These features are a subset of a larger group of potential inherent features that form the third line of protection (LOP-3) for the GCFR. The function of LOP-3 is to demonstrate that the inherent response of the reactor system will limit core damage even if active cooling and shutdown systems in LOP-1 and LOP-2 fail. By providing this function with inherent features, which do not depend on active components and are self-controlling, an additional level of protection against common cause failure mechanisms is provided for both protected and unprotected events. The examples of LOP-3 discussed in this paper are natural circulation core cooling to the ultimate atmospheric heat sink and inherent reactor shutdown mechanisms.

36690 (GA-A—15930) **Revised GCFR safety program plan.** Kelley, A.P.; Boyack, B.E.; Torri, A. (General Atomic Co., San Diego, CA (USA); Helium Breeder Associates, San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 27p. (CONF-800648—10). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper presents a summary of the recently revised gas-cooled fast breeder reactor (GCFR) safety program plan. The activities under this plan are organized to support six lines of protection (LOPs) for protection of the public from postulated GCFR accidents. Each LOP provides an independent, sequential, quantifiable risk barrier between the public and the radiological hazards associated with postulated GCFR accidents. To implement a quantitative risk-based approach in identifying the important technology requirements for each LOP, frequency and consequence-limiting goals are allocated to each. To ensure that all necessary tasks are covered to achieve these goals, the program plan is broken into a work breakdown structure (WBS). Finally, the means by which the plan is being implemented are discussed.

36691 (LA-UR—79-3019) **Hydrogen mixing in a closed containment compartment based on a 1-D model with convective effects. Final report.** Willcutt, G.J.E. Jr.; Gido, R.G.; Koestel, A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-801002—5). NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A transient one-dimensional finite-difference model was developed to determine the hydrogen concentration variation with position in a closed containment compartment due to radiolysis following a LOCA. The model includes mixing due to molecular and eddy diffusion and natural convection. For representative compartments, the maximum hydrogen concentration difference between the bottom and top of the compartment never exceeds 0.25 volume percent when all three mixing mechanisms are considered for a range of parameters.

36692 (LA-UR—80-1320) **Finite element modeling of fluid/thermal/structural interaction for a gas-cooled fast reactor core.** Bennett, J.G.; Ju, F.D. (Los Alamos Scientific Lab., NM (USA); New Mexico Univ., Albuquerque (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-801003—2). NTIS, PC A02/MF A01.

From Symposium on computational methods in nonlinear structural and solid mechanics; Washington, DC, USA (6 Oct 1980).

Two nonlinear finite element formulations for application to a series of experiments in the Gas-Cooled Fast Reactor (GCFR) development program are described. An efficient beam column element for moderately large deformations is combined with a finite element developed for an engineering description of a convecting fluid. Typical results from both elements are illustrated. A combined application for a problem typical of the GCFR loss-of-coolant experiments is illustrated. These problems are not the usual fluid structural interaction problems in that the inertia coupling is negligible while the thermal coupling is very important.

36693 (NP—25104) **Report of the Office of Chief Counsel on the Nuclear Regulatory Commission.** Gorinson, S.M. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 145p. GPO.

Section 3(d) of the President's charge to this Commission required an evaluation of the Nuclear Regulatory Commission's licensing, inspection, operation, and enforcement procedures as applied to the Three Mile Island nuclear facility. This report considers the statutory authority of the Nuclear Regulatory Commission (NRC), puts the agency into historical context, and examines the agency's important structures and practices, as illuminated by the Three Mile Island accident.

36694 (NP—25105) **Report of the Emergency Preparedness and Response Task Force.** Dynes, R.R.; Purcell, A.H.; Wenger, D.E.; Stern, P.S.; Stallings, R.A.; Johnson, Q.T. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 174p. GPO.

The accident at Three Mile Island (TMI) marked the first time in the US when traditional planning for emergencies was applied to a possible radiological emergency. This report examines the planning that existed in the counties surrounding the plant and at the state and federal levels. It also examines the responses of the various governmental units following the initial accident.

36695 (NP—25107) **Reports of the Office of Chief Counsel on emergency preparedness, emergency response.** Gorinson, S.M.; Kane, K.P. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 334p. GPO.

This report examines the principal influences that shaped the emergency planning in place at the time of the TMI accident. The report is divided into two parts. The first part reviews the Nuclear Regulatory Commission's (NRC) requirements on reactor siting and emergency planning, and traces the influence of that regulatory approach in the emergency plan developed by the utility. The second part examines federal, state, and local planning activities in this regulatory climate during the years before the TMI accident.

36696 (NP—25108) **Report of the Public's Right to Information Task Force.** Rubin, D.M.; Chaapel, H.A.; Cunningham, A.M. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 268p. GPO.

Information is presented concerning the public information chronology; MET ED public relations; flow of public information during the accident at Three Mile Island; flow of public information on five key events during the accident at Three Mile Island; the journalist's perspective; content analysis of mass media coverage of the accident; local radio news coverage of the accident; and qualitative survey of newspaper coverage of the accident.

36697 (NP—25109) **Reports of the Public Health and Safety Task Force on public health and safety summary; health physics and dosimetry; radiation health effects; behavioral effects; and public health and epidemiology.** (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 428p. GPO.

The general objectives of the Health Physics and Dosimetry Task Group included: (1) to determine the radiation dose to the people living within the area of 50 miles around the Three Mile Island Nuclear Station during the period of March 28 to April 15, 1979; (2) to determine the radiation dose to the workers at the nuclear power plant during the period of March 28 to June 30, 1979 - the cutoff date necessitated by the deadline of the Commission's report; and (3) to evaluate federal, state, and utility company programs concerned with the protection of human populations and their environment from the possible hazards of ionizing radiation, and the

efficacy of these radiation protection programs during the nuclear accident at TMI.

36698 (NP—25110(Vol.1)) **Reports of the Technical Assessment Task Force on technical staff analysis reports summary. Summary sequence of events.** Jaffe, L.; Bland, W.M. Jr.; English, R.; Eytchison, R.M.; Reilly, D.; Stratton, W.; Tew, J.L. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 147p. GPO.

The subjects studied and the scope of the analysis were directed to those aspects of some specific relevance to the TMI-2 accident. The determination of what actually happened (The Summary Sequence of Events) is therefore a most important contribution to all of the studies. In general, the analyses are directed to describing what happened, explaining why it happened, an assessment of the conditions that made the occurrences possible, an assessment of the results of the accident, and to a limited degree, an examination of what might have happened had the accident worsened.

36699 (NP—25110(Vol.2)) **Reports of the Technical Assessment Task Force on chemistry; thermal hydraulics, core damage; WASH 1400 - reactor safety study; alternative event sequences.** Jaffe, L.; Bland, W.M. Jr.; English, R.; Eytchison, R.M.; Reilly, D.; Stratton, W.; Tew, J.L. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 236p. GPO.

The following topics at TMI-2 were reviewed: zirconium's reactions with water and the fuel uranium dioxide (UO_2); the fission products released from the fuel elements; and the hydrogen produced and its likelihood of exploding in the reactor vessel. The findings are presented.

36700 (NP—25110(Vol.3)) **Reports of the Technical Assessment Task Force on selection, training, qualification, and licensing of Three Mile Island reactor operating personnel; technical assessment of operating, abnormal, and emergency procedures; control room design and performance.** Jaffe, L.; Bland, W.M. Jr.; English, R.; Eytchison, R.M.; Reilly, D.; Stratton, W.; Tew, J.L. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 209p. GPO.

As a part of the effort to identify and evaluate the possible causes of the Three Mile Island accident, an analysis of operator training, qualification, licensing, selection, and manning was conducted by the staff. The study included review of documents, interviews, and depositions at Three Mile Island, Babcock and Wilcox, and the Nuclear Regulatory Commission (NRC) during June, July, and August 1979. Analysis of the information obtained was conducted almost exclusively by the writer. This paper examines the roles of the actors involved in training and it reviews the various programs which were intended to staff Three Mile Island with sufficient numbers of competent, trained operators and supervisors. The analysis includes a review of the regulations concerning operator training and licensing; describes how the requirements were implemented by the NRC, Metropolitan Edison Company (Met Ed), and Babcock and Wilcox Company (B and W), and then evaluates the programs conducted by these three organizations.

36701 (NP—25110(Vol.4)) **Reports of the Technical Assessment Task Force on quality assurance; condensate polishing system; closed emergency feedwater valves; pilot-operated relief valve design and performance; containment: transport of radioactivity from the TMI-2 core to the environs; iodine filter performance; recovery: TMI-2 cleanup and decontamination.** Jaffe, L.; Bland, W.M. Jr.; English, R.; Eytchison, R.M.; Reilly, D.; Stratton, W.; Tew, J.L. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 352p. GPO.

A review of the independent assessment program for nuclear power plants as defined by the Nuclear Regulatory Commission (NRC) Quality Assurance, Reliability, and System Safety requirements and regulations was conducted by a team of commission staff and consultants. This team reviewed, examined, and assessed the regulations, organizations, procedures and practices involved in those NRC and utility overview activities meant to assure the safe operation of a nuclear power plant. The staff found that the regulations and overall review process applies only to a portion of the plant defined as safety-related and do not fully utilize the rigorous safety analysis and reliability engineering techniques currently applied to other safety critical programs or industries. The review also indicates that the management structures that have evolved as a result of this narrow definition of NRC responsibility do not provide for an independent assessment of many critical functions and operations.

36702 (SAND—79-0931C) **Core-concrete molten pool dynamics and interfacial heat transfer.** Benjamin, A.S. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 30p. (CONF-801002—8). NTIS, PC A03/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Theoretical models are derived for the heat transfer from molten oxide pools to an underlying concrete surface and from molten steel pools to a general concrete containment. To accomplish this, two separate effects models are first developed, one emphasizing the vigorous agitation of the molten pool by gases evolving from the concrete and the other considering the insulating effect of a slag layer produced by concrete melting. The resulting algebraic expressions, combined into a general core-concrete heat transfer representation, are shown to provide very good agreement with experiments involving molten steel pours into concrete crucibles.

36703 **Fuel porosity and crack effects on transient overpower analysis.** Fox, G.L. (Westinghouse Electr Corp, Richland, Wash). *J. Pressure Vessel Technol.;* **102**: No. 1, 22-27(Feb 1980).

ENERGY STORAGE

PUMPED HYDRO

36704 (WR—28-1-79-100) **Effects of operation of Raccoon Mountain pumped-storage project on Nickajack Reservoir flow conditions.** Garrison, J.; Price, J.T. (Tennessee Valley Authority, Norris (USA)). Jan 1980. 25p. Tennessee Valley Authority, Norris, TN.

The results from a study to determine the effects of Raccoon Mountain Pumped-Storage Plant operations on flow conditions within Nickajack Reservoir are presented. Computer simulations and field studies have shown that flow reversals occur in Nickajack Reservoir as a result of the power peaking operations of the Nickajack and Chickamauga hydroelectric plants, both situated on the Tennessee River. The primary cause of these reversals is attributable to shutdowns of the Chickamauga turbines. The focus of this study is on flow reversals near the Moccasin Bend sewage treatment plant and near the Tennessee American water treatment plant, both of which are located on the Tennessee River near Chattanooga. Results from the study show that, under normal and extreme operating conditions at Chickamauga and Nickajack Dams, operation of the Raccoon Mountain Pumped-Storage Plant has no appreciable influence on flow reversals at the two plant sites.

CAPACITOR BANKS

REFER ALSO TO CITATION(S) 37444

FLYWHEELS

REFER ALSO TO CITATION(S) 36890

THERMAL

REFER ALSO TO CITATION(S) 36507, 36857

36705 (DOE/NASA/0100—79/1) **High temperature thermal energy storage in steel and sand.** Turner, R.H. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1979. Contract AI01-77CS51040. 94p. NTIS, PC A05/MF A01.

The technical and economic potential for high temperature (343°C, 650°F) thermal energy storage (TES) in hollow steel ingots, pipes embedded in concrete, and for pipes buried in sand is evaluated. The intended TES application is integration into a steam power plant, perhaps to provide an otherwise baseload plant. It was determined that concrete would separate from pipes due to thermal stresses, causing unacceptable thermal resistances. Therefore, for study, concrete was replaced by sand, which is free from thermal stresses. The original hollow steel ingot concept underwent a series of evolutionary changes, and it was finally decided that all variations were not cost effective compared to the sand-pipe approach. Therefore, the sand-pipe thermal storage unit (TSU) was evaluated in depth to assess the approximate tube spacing requirements consistent with different system performance characteristics and also attendant system costs. A series of performance cost curves were generated from which tube spacing and tube diameter performance comparisons were obtained. The curves served as inputs for the cost analysis. The major conclusion of the study is that for large TSUs which do not require fast response times, the sand-pipe approach offers attractive possibilities. A pipe diameter about 9 cm (3.5 in) and pipe spacing of approximately 25 cm (10 in), with sand filling the interspaces, appears appropriate. Such a TSU system designed for 8 hours charge/discharge cycle has an energy unit storage cost (C/sub E/) of $2.63/kWhr-t and a power unit storage cost (C/sub P/) of $42/kW-t (in 1977 dollars).

36706 (DOE/PE—03871-01, pp 19.1-19.23) **Thermal energy storage.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The technical, economic, safety and environmental aspects of thermal energy storage systems are discussed and compared. Systems based on sensible and latent heat storage and systems involving chemical reactions are included. It is concluded that potential thermal storage applications are widespread. However, at present, only systems using solar and electric input for residential and commercial space heating, water heating, and air conditioning have been commercialized. The cost-effectiveness of systems will depend on cost of various energy sources including utility rate structures which encourage off-peak use. (LCL)

36707 (LBL—10208) **Seasonal thermal energy storage in aquifers: mathematical modeling studies in 1979.** Tsang, C.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01.

During fiscal year 1979 (October 1978-September 1979) major LBL work involved the numerical modeling of the recently completed hot water storage field experiments at Auburn University. Work was also done, under separate funding, on the basic understanding of thermal stratification dispersion, and buoyancy flow in an aquifer used for hot or cold water storage. These questions are crucial in determining the efficiency of aquifer storage and will be discussed elsewhere. The results of the simulation of Auburn field experiments are summarized.

36708 **Low cost heat storage tank and heat exchanger .** O'hanlon, E. US Patent 4,210,201. 1 Jul 1980. Filed date 28 Feb 1978. vpp.

A description is given of an assembly for storing a quantity of heat in a heat storage means and later retrieving a substantial portion of said heat as required and comprising: a waterproofed tank-like enclosure formed of heavily insulated material and including at least one inlet and one outlet aperture, each extending through said enclosure; pipe means extending through said enclosure between said inlet and outlet apertures for providing an air flow passageway through said enclosure and having means for allowing condensation to pass between the airstream within the pipe and said heat storage means; blower means in fluid communication with said inlet for introducing a stream of air into said pipe means; and, heat storage means comprising a mixture of solids and water surrounding said pipe means for receiving heat from the air flowing through said pipe means, for storing said heat within said enclosure over an extended period of time and for returning a substantial portion of said heat to the stream of air flowing through said pipe means.

CHEMICAL

REFER ALSO TO CITATION(S) 36709

BATTERIES

REFER ALSO TO CITATION(S) 37436

36709 (LBL—10000, pp 511-524) **Energy storage.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

The overall aim of this program is to improve the energy efficiency, lower the capital cost, and increase the materials yield of electrochemical processes employed in the direct conversion of chemical to electrical energy in galvanic cells and in the production of materials by electrolysis. Studies within this project are summarized. These studies deal with surface morphology of metals in electrodisposition, anodic surface layers on battery materials, metal couples in non-aqueous solutions, analysis and simulation of electrochemical systems, efficiency improvements in aluminum reduction cells, and engineering analysis of gas evolution in electrolysis. (LCL)

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 36881

36710 (AD-A—079690/4) **Investigation of methods to improve the low temperature charge acceptance of lead-acid batteries. Technical note.** Valeriote, E.M.L. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1979. 7[illegible]NTIS, PC A03/MF A01.

Investigation of the causes of poor low-temperature charge acceptance of the lead-acid battery at DREO has been primarily directed towards understanding and improving positive electrode characteristics. However, studies of the negative electrode, of electrolyte and electrode additives, of electrolyte composition, and of charging and heating methods for improving charge acceptance are also discussed. Previous research and recent advances are reviewed. Possible improvements are suggested. Recommendations for further research and development are made, based on the encouraging results of the current work and on the accumulated knowledge represented by the work reviewed.

PERFORMANCE AND TESTING

36711 (AD-A—079687/0) **Nickel-cadmium aircraft batteries: management for engine cranking.** Feldman, K.; Verville, G. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1979. 40p. NTIS, PC A03/MF A01.

Nickel/cadmium aircraft batteries with Celgard barrier materials may be freely used for cranking turbine engines. However, frequent use for this purpose with insufficient intervening cooling still results in successive increases in battery temperature. The experiments were terminated when 'hot spot' temperatures between the cells reached 100C. Short-term experiments indicated no apparent problems. In long-term use for cranking, performance was found to deteriorate as water depletion, due to overcharge, became severe. Replacement of water and deep cycling restored the original condition. Improved cranking performance was found with initial electrolyte concentrations below the customary 30% potassium hydroxide. It is emphasized that the above comments do not apply to batteries with cellophane barriers.

36712 (DOE/PE—03871-01, pp 20.1-20.16) **Secondary batteries.** Nov 1979.

In Distributed energy systems: a review of related technologies.

Batteries of value for use in distributed energy systems are discussed. Technical and economic aspects of lead-acid, Zn/Cl_2, Na/S, and Li/FeS batteries are addressed. As immediate opportunities are limited to lead-acid batteries, this system is considered in more detail. 6 tables. (RWR)

MATERIALS, COMPONENTS, AND AUXILIARIES

36713 (AD-A—079688/8) **Pulse capability of the airi lead chloride electrode. Technical note.** Donaldson, G.J.; Barnes, W.D. (Defence Research Establishment, Ottawa, Ontario (Canada)). Nov 1979. 25p. NTIS, PC A02/MF A01.

The objective of the study was to evaluate the pulse discharge performance of lead chloride electrodes for the active sonobuoy battery application. Experimental work was carried out using $Mg/PbCl_2$ cells which were pulse discharged in 3.25% artificial seawater at ambient temperatures (22-25 C). Pulses of 100 milliseconds duration were applied every ten seconds by switching the cells from their steady discharge load to the pulse discharge load. It was found that the steady rate of discharge had to be maintained at about 5-10 mA per sq cm in order to permit a sufficiently rapid response to the application of the pulse load without unduly sacrificing electrode capacity. The $Mg/PbCl_2$ cell was required to accept a pulse load greater than the steady load by a factor of approximately 25; the resulting loss of cell output voltage was about 0.6 volts. Although Mg/AgCl cells suffer about the same loss of output, the levels are about 0.5 volts higher in both steady and pulsed discharge modes than those for the $Mg/PbCl_2$ cell. A further serious disadvantages of the $PbCl_2$ electrode is its greater size and weight compared to silver chloride. Lead chloride electrodes do not offer a performance advantage over silver chloride for active sonobuoy batteries. In view of the impending conversion of all types of sonobuoys to the use of lithium batteries in about five to eight years time there is little advantage to pursuing the development of the lead chloride electrode for such applications.

36714 **Microporous film battery separator .** Doi, Y.; Fugii, O.; Hanamura, T.; Kaneko, S. (to Asahi Kasei Kogyo K K (Japan)). US Patent 4,210,709. 1 Jul 1980. Filed date 1 Aug 1978. vp.

The microporous film described has a matrix comprising 40 to 90 vol. % of a polyolefin having a number average molecular weight of 15,000 or more and 10 to 60 vol. % of an inorganic filler, said matrix having therein void spaces at a rate of 30 to 75 vol. % based on the volume of the film; and 2 to 20 wt % based on the total weight of the polyolefin and the inorganic filler, of an organic substance which is substantially insoluble in and inert to sulfuric acid and has a solubility parameter ranging from 7.3 inclusive to 8.4 exclusive; said organic substance, in its majority, adhering to the overall surface of the film including the outer surfaces of the film and the surfaces of the polyolefin walls defining said void spaces in cooperation with said inorganic filler; said microporous film being prepared by a method comprising blending said polyolefin, said inorganic filler, and an organic liquid having a solubility parameter ranging from 4 to 9.9 inclusive in amounts of 10 to 60 vol. %, 7 to 42 vol. % and 30 to 75 vol. %, respectively, based on the whole volume of the polyolefin-filler-organic liquid composition, the amount of the polyolefin being 2/3 to 9 multiple of the amount of the inorganic filler; subjecting the resulting blend to molding to form a film;

extracting from said film the organic liquid to form a matrix which comprises 40 to 90 vol. % of the polyolefin and 10 to 60 vol. % of the inorganic filler and having therein void spaces at a rate of 30 to 75 vol. % based on the volume of the film; and applying to the matrix the organic substance which is substantially insoluble in and inert to sulfuric acid and has a solubility parameter ranging from 7.3 inclusive to 8.4 exclusive so that said organic substance adheres to the overall surface of the film in an amount of 2 to 20 wt % based on the total weight of the polyolefin and the inorganic filler.

APPLICATIONS

REFER ALSO TO CITATION(S) 36804

ENERGY PLANNING AND POLICY

ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 36806, 36864

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 36726, 36733, 36738, 36745, 36746, 36747, 36763, 36769, 36771, 36773, 36810, 36828, 36838

36715 (DOE/CS/10046—1(Rev.)) **Inventory of state energy models.** Melcher, A.G.; Gist, R.L.; Underwood, R.G.; Weber, J.C. (Colorado School of Mines Research Foundation, Inc., Golden (USA)). 31 Mar 1980. Contract AC02-79CS10046. 128p. NTIS, PC A07/MF A01.

These models address a variety of purposes, such as supply or demand of energy or of certain types of energy, emergency management of energy, conservation in end uses of energy, and economic factors. Fifty-one models are briefly described as to: purpose; energy system; applications;status; validation; outputs by sector, energy type, economic and physical units, geographic area, and time frame; structure and modeling techniques; submodels; working assumptions; inputs; data sources; related models; costs; references; and contacts. Discussions in the report include: project purposes and methods of research, state energy modeling in general, model types and terminology, and Federal legislation to which state modeling is relevant. Also, a state-by-state listing of modeling efforts is provided and other model inventories are identified. The report includes a brief encylopedia of terms used in energy models. It is assumed that many readers of the report will not be experienced in the technical aspects of modeling. The project was accomplished by telephone conversations and document review by a team from the Colorado School of Mines Research Institute and the faculty of the Colorado School of Mines. A Technical Committee (listed in the report) provided advice during the course of the project.

36716 **Low-cost general energy/analytic information system.** Reisman, A.W.; Allentuck, J. (Brookhaven National Lab., Upton, NY). pp 294-299 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The current energy crisis, reflected primarily in increased petroleum prices, has underscored the need for energy planning in the formulation of economic-development plans in industrialized and emerging countries. This paper outlines the structure and data requirements for a low-cost energy analytic information system having a regional capability. It examines the kinds of planning decisions which require energy-information-system support, summarizes the information content of an energy-information system, and describes its basic analytic capabilities.

36717 **Energy-emergency-management information system.** Yaffe, B.M. (US DOE, Washington, DC). pp 315-319 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The Energy Information Administration (EIA) in the U.S. Department of Energy has undertaken the development of a management information system to be used by Federal and State officials responsible for dealing with energy emergencies. The system must meet challenging requirements in several areas: (1) It will be multi-fuel in scope, and will require development of an integrated data base interrelating information across fuel types, transportation modes, and end-use sectors; (2) it will serve users at various government levels, and will involve states in the development process; and factual data and forecasts will need to be timely and easily accessible, and communications among users must be facilitated. This paper describes the design approaches being taken by EIA in building an interim system.

36718 **Energy-circuit language simulation model of Hillsborough County, Florida.** Swaney, D. (Univ of Florida, Gainesville). pp 486-493 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

A computer-simulation model of ecologic-economic interactions of regional scale was developed for Hillsborough County, Florida. The model uses the framework of the Energy Circuit Language of H.T. Odum and the DYNAMO computer simulation language to simulate a set of nonlinear differential equations which describe the dynamics of energy and land exchange in Hillsborough County. The model consists of three main sectors: the agricultural system, the "natural" (undeveloped) system, and the urban (commercial-industrial-residential) system. Exchange of land area between the sectors is governed by a maximum-productivity algorithm based on the principle of "maximum power". 7 refs.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 36215, 36218, 36219, 36220, 36221, 36222, 36223, 36225, 36226, 36229, 36233, 36234, 36382, 36732, 36736, 36743, 36745, 36748, 36750, 36762, 36772, 36775, 36824, 36833, 36839, 36849, 36856, 36863

36719 (BNL—50923) **Comparative assessment of energy-economy interactions.** Goettle, R.J. IV; Hudson, E.A.; Lukachinski, J. (Brookhaven National Lab., Upton, NY (USA)). Dec 1978. Contract AC02-76CH00016. 62p. NTIS, PC A04/MF A01.

This analysis is concerned with the impact of energy-policy measures on the level, growth, and structure of the US economy. In particular, the nature and magnitude of the causal relationship between variations in the prices of various energy forms and economic performance, as measured by real gross national product (GNP), is studied. The combined Brookhaven National Laboratory/Dale W. Jorgenson Associates (BNL/DHA) energy-economy model system is used to determine the economic effects of three energy-price futures combined with an invariant set of energy policies. The price alternatives are intended to characterize the uncertainty that exists in the policy-planning environment. In addition, the results are compared to those obtained from another DOE-sponsored analysis which used the Data Resources, Incorporated (DRI) quarterly macroeconomic model to assess the effects of these same three cases. Significant numerical differences in the results from these modeling systems are observed and are attributed to structural differences between the two methodologies. The methodological issues emerging from this comparison have important policy implications which are independent of the specific numerical coaclusions. Since it is uncertain which, if either, of the models is correct, the use of one for policy analysis entails the risk that policy will be predicated on inaccurate information. This risk is analyzed within an explicit framework and clear decision rules for information selection and the choice between the modeling systems are formulated.

36720 (CONF-790890—, pp C.1-C.15) **Catalogue of current foreign assistance programs.** Ashworth, J.H. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

This series of charts detail current foreign assistance programs. In most cases, the purpose of the project is the acceleration of economic and social development, not the installation of solar systems. (MHR)

36721 (CONF-790890—, pp C.29) **Financing exports and ovrseas business ventures.** Alder, A.W. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

36722 (CONF-790890—, pp C.139-C.149) **The technology explosion how to harness it for world development.** Cooper, J.S. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

A number of key issues are raised and various options are outlined that are paramount to any company's present and future plans for business involvement in developing countries. (MHR)

36723 (CONF-800491—, pp 536-539) **Energy implications of an aging population.** Cambel, A.B. (George Washington Univ., DC); Heffernan, G.A.; DeVita, C.J.). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36724 (DOE/ER/10041—01) **Energy implications of an aging population.** (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). Aug 1980. Contract AC01-79ER10041. 70p. NTIS, PC A04/MF A01.

This study provides various demographic, medical, and economic information relative to energy usage on a segment of the population, the elderly, which is growing in absolute numbers and relative population percentage. This growth is expected to continue well into the twenty-first century. The US aging population numbered 3.1 million in 1900, and by 1977 it had climbed to 23.5 million. It can be stated with reasonable certainty that this figure will rise to 31 million in the year 2000 and 43 million in the year 2020. These figures, corresponding to more than 10% of our population, are by no means insignificant. As our fossil-fuel reserves are being depleted and the cost of energy mounts, it becomes apparent that the elderly will become increasingly vulnerable to the energy crisis, primarily beause of their physical tendency to infirmity, their economic and social situation, and their susceptibility to psychological depression. This white paper concentrates on those aspects of aging and the nation's energy problem which are not usually related in our everyday consideration of these as separable problems. It seeks to identify the peculiar energy problems of the aged and to consider alternatives in the solution of these problems in light of modern technology.

36725 (PNL—3529) **Institutional analysis for energy policy.** Morris, F.A.; Cole, R.J. (Battelle Human Affairs Research Center, Seattle, WA (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 178p. NTIS, PC A09/MF A01.

This report summarizes principles, techniques, and other information for doing institutional analyses in the area of energy policy. The report was prepared to support DOE's Regional Issues Identification and Assessment (RIIA) program. RIIA identifies environmental, health, safety, socioeconomic, and institutional issues that could accompany hypothetical future scenarios for energy consumption and production on a regional basis. Chapter 1 provides some theoretical grounding in institutional analysis. Chapter 2 provides information on constructing institutional maps of the processes for bringing on line energy technologies and facilities contemplated in RIIA scenarios. Chapter 3 assesses the institutional constraints, opportunities, and impacts that affect whether these technologies and facilities would in fact be developed. Chapters 4 and 5 show how institutional analysis can support use of exercises such as RIIA in planning institutional change and making energy policy choices.

36726 (UCID—18794) **Study of foresight modeling using the LLNL Economic Modeling System.** Bell, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01.

This report presents the results of a modeling study performed with the Livermore Economic Modeling System (EMS), using a number of different methods to model resource-owners' foresight. Qualitatively, the effect of a gven scheme is, a priori, known: if future prices are perceived to be relatively higher, present-time rents will be relatively higher; lower perceived future prices will yield lower present-time rents. For resources which undergo large depletion during the time frame of the modeling study, rent can be a large - or even the dominant - component of the transaction prices for those resources. This study provides quantitative information about the magnitude of the differences in rents and prices yielded by the various simulations of foresight under consideration.

36727 **Energy as a determinant of investment behavior.** Uri, N.D. (Dept. of Energy, Washington, DC). *Energy Econ.;* **2**: No. 3, 179-183(Jul 1980).

Studies of the determinants of investment behavior have so far failed to consider the effects of changing energy prices. After reviewing the theory of investment analysis, an econometric examination is made of the role of energy prices in US investment activity. The price of energy is found to be an important factor in adequately explaining investment decisions, and its importance is likely to grow. 21 references, 2 tables.

36728 **Compensation for inflation under alternative regulatory formulas: a rejoinder.** Anderson, R.E. (Federal Energy Regulatory Commission, Washington, DC). *Public Util. Fortn.;* **104**: No. 12, 32-35(6 Dec 1979).

This article sets forth some interesting and significant conclusions concerning public-utility rate making in periods of high inflation. As its point of departure, it takes issue with the conclusion in another article by Thomas G. Marx which appeared earlier in Public Utilities Fortnightly (June 7, 1979) that adequate compensation to investors will be provided only by allowing a rate of return equal to the current cost of capital on a fair-value rate base. The matter is not that simple, Mr. Anderson suggests, and describes some of the assumptions and perceptions which he sees as essential for an understanding of the impact of high rates of inflation on all business and governmental activities.

36729 **Life-quality accounting in alternative energy policy.** Daneke, G.A.; Lawrence, A. (Univ of Michigan, Ann Arbor). pp 622-637 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

A clearer understanding of all of the diverse interrelationships would seem vital to securing a smooth transition into the energy future, and such an understanding may only result from the development of a coherent and comprehensive life-quality accounting system. It is the purpose of this discussion to review briefly efforts in this area, emphasizing the need for methods which go beyond the traditional cost-benefit approach. Observations will take special note of techniques and strategies devised to deal with final realm listed above - i.e., that of a life-quality accounting of alternative energy technologies. One of the most common methods used to address the social and economic impact of a given policy or project is cost-benefit analysis. Cost-benefit analysis is applied welfare economic theory. Conceptually, it is an attempt to apply market rationality to public goods. 23 refs.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 35937, 36674, 36675, 36733, 36738, 36740, 36772, 36774, 37146, 37151, 37249, 37250

36730 **Energy and environmental law in transition: a practitioner's perspective.** Lew, G.; Silverstrom, L. *Ecol. Law Q.;* **8**: No. 4, 818-830(1980).

Recent efforts to develop a national energy policy have involved the need to make fundamental changes in how energy is developed and how it is used. This has generated a number of environmental laws concerning the development of coal, synfuels, and nuclear energy which seek to preserve and improve the human and natural environment. The authors see the concept of an Energy Mobilization Board, authorized to compromise these laws and prevent delays of energy projects as improper. They suggest five assumptions that should be incorporated as the basis for a coordinated strategy: (1) conservation should have first priority; (2) conservation can not substitute for a primary future fuel source; (3) environmental policy should be flexible; (4) environmentalists and developers should identify and focus their debate on basic issues; and (5) environmentalists should work to integrate and assess environmental data into the decision-making process. 43 references. (DCK)

36731 **Relative risk assessment and projected body burdens: a tool for energy-use management.** Gasper, J.R.; Dauzvardis, P.A. (Argonne National Lab., Ill). pp 457-467 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The growing gap, actual or artificially induced, between U.S. demand for petroleum and available supplies serves to emphasize the need for both optimal use of existing energy resources and development of new energy sources and supplies. Accomplishing these goals means making trade-offs between health, economic and social, environmental, and energy availability considerations. Many tools and much information are available to the policy maker to assess the impacts of these trade-offs. In some areas such as health assessment, gaps exist in both methodology and information. This paper describes a method for dealing with one such gap, human response to hazardous pollutants emitted by energy technologies, and presents a sample application of the methodology. 24 refs.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 36012, 36764, 36841

36732 (LA—8455-MS) **Energy-related applications of helium: a revision of the ERDA-13 data base.** Hammel, E.F.; Krupka, M.C. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 180p. NTIS, PC A09/MF A01.

A re-examination, revision, and re-evaluation of the data base contained within the 1975 document, ERDA-13, The Energy-Related Applications of Helium, were completed and results are presented in this report. New technical and resource data, current legislative proposals, updated supply-and-demand relationships, latest legal developments, programmatic changes affectng the future demand for helium, socio-economic aspects, and the effects of the latest energy-consumption projections were considered and are discussed. In contrast to ERDA-13, however, explicit recommendations with respect to the formulation of Federal helium policy, as it pertains to the energy-related applications of helium, are not given.

36733 **Global systems ecology model.** Alexander, J.F. Jr. (Univ of Fla, Gainesville). pp 443-456 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Proper management of our nation's energy resources requires development of the basic understanding of the nature of energy. This paper discusses a global energy-web model developed to aid conceptually in understanding the basis of the world's energy resources. Global-energy-quality factors are developed from the quantity of energy concentrated by the world web into a particular resource. The ability of a particular energy resource to perform useful work may be directly related to quantity of energy concentrated in the world web. 33 refs.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 36751, 36777

36734 (DOE/CS/20095—01) **Third Program Plan for DOE's participation in the IEA Working Party on Energy-Conservation Research and Development.** (Resource Planning Associates, Inc., Washington, DC (USA)). Jun 1980. Contract AC01-79CS20095. 78p. NTIS, PC A05/MF A01.

The Plan documents the projects currently being conducted by the working party in which DOE is participating and the projects proposed by DOE for consideration by other IEA member nations. Chapter 1 reviews current and planned DOE commitments to existing implementing agreements: buildings and community systems; energy conservation in building complexes; energy cascading; heat pumps with thermal storage; advanced heat pumps; combustion; heat transfer and heat exchangers; energy storage; cement manufacturer; and high-temperature materials for automotive propulsion systems. Chapter 2 reviews planned DOE commitments to new implementing agreements: combustion; pulp and paper; iron and steel; food processing; urban waste; and alcohol additives to fuel. Appendix A discusses the mechanisms for establishing implementing agreements and annexes. Appendix B lists working party members and Appendix C describes the evaluation methodology.

36735 **EPRI's role in railroad electrification.** *EPRI J.;* **5**: No. 6, 28(Jul 1980).

A national commitment with appropriate funding is needed before railroad electrification can play a significant role in the transportation sector. The Electric Power Research Institute (EPRI) and US utilities are interested in the opportunity to use rail rights-of-way for towers and the possibility of reducing the costs of coal transport. Electrification will become more cost-effective as oil prices rise, but only one percent of US railroads are presently electric. EPRI's role will be to help develop techniques for utilities to forecast load and supply needs, eliminate electronic interference, and reduce the costs of an electrification program. (DCK)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 36100, 36674, 36675, 36693, 36694, 36695, 36696, 36697, 36698, 36699, 36700, 36701

36736 **Role of nuclear energy in future supply options.** Zebroski, E. (EPRI, Palo Alto, Calif). pp 120-124 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Nuclear power is now regarded by a significant section of the public, of legislatures, and an almost overwhelming section of the media - as having become a nonviable option, at least for expansion of energy supply. This political fact makes largely irrelevant a large part of the technical discussion of the virtues or deficiencies of nuclear energy. This paper therefore puts fairly narrow limits on the probable role of nuclear power during the critical periods from now to 1990.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 36857, 36876, 36880, 36888

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 36839, 36855, 36857, 36858, 37078

36737 (DOE/PE—03871-01, pp 22.1-22.34) **Industrial cogeneration.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The prospects for industrial cogeneration of electric power and process heat are examined by discussing the technical aspects of cogeneration using steam or gas turbines or diesel engines and the financial and economic factors which have resulted in a decline in industrial cogeneration. The government actions which could result in a very significant increase in cogeneration in the future are listed. (LCL)

CONSERVATION

REFER ALSO TO CITATION(S) 36734, 36805, 36807, 36814, 36821, 36829, 36830, 36831, 36840, 36845, 36846, 36852, 36856, 36857, 36858, 36862, 36865, 36866

36738 (BNL—51110) **Energy-environmental impacts of five energy conservation measures in the Middle Atlantic and Pacific states.** Moskowitz, P.D.; Edelson, E.; Le, T.Q.; Sevian, W.A.; Smith, J.E.; Struth, A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract AC02-76CH00016. 76p. NTIS, PC A06/MF A01.

Estimates of some energy and environmental impacts for five different energy-conservation measures (district heating, industrial cogeneration, retrofit, rate reform, and vehicle redesign) were prepared for two different regions (Middle Atlantic and Pacific) and two different time periods (1985 and 2000) based upon data presented in regional reference energy systems developed at BNL. Results of the analysis indicate that regional energy use can be reduced by <1 to 6%. Vehicle redesign produces the greatest oil savings. Retrofit and district heating can each reduce oil and natural gas use. Industrial cogeneration can significantly reduce use of fuels consumed in central-station electricity production (e.g., coal and nuclear) but at an energy penalty incurred by industry: increased dependence on oil and natural gas could result. Rate reform and retrofit each reduce emissions production in rough proportion to the quantities of energy saved. Vehicle redesign reduces only supply sector emissions; end-use emissions are not affected even though gasoline use significantly decreases. District heating may reduce regional emissions but increase local emission burdens where waste heat is being produced. Local air quality need not be adversely affected, although long-range-transport potential increases. The district-heating concept may also have important effects on future power-plant siting options. Depending on the mix of fuels consumed, industrial cogeneration could increase regional emissions production because of the potential substitution of dirty fuels (coal, industrial wastes, and oil) for clean fuels (natural gas and nuclear); this may be particularly important in the Pacific region. In general, per unit reductions in electrical demand appear to produce greater environmental benefits than equivalent reductions in fuels used directly in an end-use device.

36739 **Effects of Federal policy on the implementation of energy-efficient industrial technologies.** Evans, A.R.; Grogan, P.J.; Wyant, F.R. (Argonne National Lab., Ill). pp 782-786 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper provides an overview of some of the aspects of federal policy to accelerate the implementation of industrial energy-conservation technologies. A general method of policy analysis is presented which may be applied to the analysis of the implementation of new technologies. Ongoing work at Argonne National Laboratory is analyzing specific conservation policies and attempting to show some of the interactions among various policy measures.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 36715, 36746, 36747, 36809, 36824

36740 (CONF-800491—, pp 590-593) **Power satellite: toward which energy crisis?.** Heppenheimer, T.A. (Center for Space Science, Fountain Valley, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36741 (CONF-800491—, pp 631-634) **Alternative future energy price/demand scenarios.** Ayres, R.U. (Carnegie-Mellon Univ., Pittsburgh, PA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

36742 (CONF-800491—, pp 635-639) **Uncertainty in energy cost comparisons.** Bragg, J.K. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The uncertainty in projecting energy system costs into the future is so great that a single number comparison of the life-cycle of different systems may be misleading as a basis for decision. However, it is also difficult to put comparisons on a probabilistic basis, particularly when the major cost elements of two competing systems are different in character. The present work illustrates some of the problems in a comparison of SPS and coal technologies for the generation of electricity.

36743 (EPRI-WS—78-142) **Workshop proceedings: noneconomic factors in energy supply and demand.** Schmid, G.; Lipinski, A. (Institute for the Future, Menlo Park, CA (USA)). Jun 1980. 51p. (CONF-7906179—(Summ.)). NTIS, PC A04/MF A01.

From Noneconomic factors in energy supply and demand workshop; Airlie, VA, USA (18 Jun 1979).

Uncertainty in energy forecasting arises, in part, from inadequate understanding of noneconomic factors that bear on energy choices and from the difficulty of modeling these factors. Forecasting models based on purely economic factors do not adequately reflect the current circumstances in the US. The workshop participants identified the political, policymaking, regulatory, and social variables that influence the planning processes of utilities today; they also reviewed the modeling techniques for dealing with these noneconomic variables and provided a number of new suggestions for handling them in decision-oriented modeling. Suggestions of areas of future research in modeling noneconomic factors relevant to utility management were made. Brief summaries are presented here of specific papers presented on: politics in the Middle East, land-use decisions, health concerns, demographic factors, technology, government regulation, consumer values, and organizational adjustments.

36744 (NP—25005, pp 12p, Paper 2) **Future energy requirements.** Mital, C.K. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

The growth of human energy demand is followed. The evolution of the demand for energy continues to grow in substantial measure as a result of the emergence of new technologies. But the evolutionary competitive process in which a new technological species drove an older species to extinction brought many benefits to human kind. The changes in energy consumption per capita are noted and energy supplies are short in most areas. The energy shortage is mainly responsible for pushing countries to find new alternate sources of energy as rapidly as they can. Any major changes in primary energy sources will require substantial alterations in governmental policies inluding energy pricing policies, very large capital investments, and solution of a number of technical difficulties.

36745 **Mid-range energy-forecasting system: structure, forecasts, and critique.** DeSouza, G. (Arthur D. Little, Inc., Cambridge, MA). *Energy Syst. Policy;* **4**: No. 1-2, 5-24(1980).

The Mid-Range Energy Forecasting System (MEFS) is a large-scale, interdisciplinary model of the US energy system maintained by the US Department of Energy. MEFS provides long-run regional forecasts of delivered prices for electricity, coal, gasoline, residual, distillate, and natural gas. A number of sets of MEFS forecasts are usually issued, each set corresponding to a different scenario. Because it forecasts prices and since these forecasts are regularly disseminated, MEFS is of considerable practical interest. A critical guide of the model's output for potential users is provided in this paper. The model's logic is described, the latest forecasts from MEFS are presented, and the reasonableness of both the forecasts and the methodology are critically evaluated. The manner in which MEFS interfaces with the Oil Market Simulation Model, which forecasts crude oil price, is also discussed. The evaluation concludes that while there are serious problems with MEFS, selective use can prove very helpful. 17 references, 1 figure, 2 tables.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 35891, 35987, 36719, 36722, 36725, 36726, 36729, 36730, 36739, 36758, 36759, 36760, 36764, 36863

36746 (BNL—51105) **Strategic cost-benefit analysis of energy policies: overview.** Davitian, H.; Groncki, P.J.; Kleeman, P.; Lukachinski, J.; Goettle, R.J. IV; Hudson, E.A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01.

This study describes three possible energy strategies and analyzes each in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. In the first, no additional programs or policies are initiated beyond those currently in effect or announced. The second is directed toward reducing the growth in energy demand, i.e., energy conservation. The third promotes increased domestic supply through accelerated development of synthetic and unconventional fuels. The analysis focuses on the evaluation and comparison of these strategy alternatives with respect to their energy, economic, and environmental consequences. The results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial environmental benefits; the synfuels policy reduces imports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs and slows the rate of economic growth. These relationships could be different if the energy savings per unit cost for conservation are less than anticipated, or if the costs of synthetic fuels can be significantly lowered. Given these uncertainties, both conservation and RD and D support for synfuels should be included in future energy policy. However, between these policy alternatives, conservation appears to be the preferred strategy. The results of this study are presented in three reports (see also BNL—51127 and BNL—51128).

36747 (BNL—51127) **Strategic cost-benefit analysis of energy policies: detailed projections.** Davitian, H.; Groncki, P.J.; Kleeman, P.; Lukachinski, J. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract AC02-76CH00016. 75p. NTIS, PC A04/MF A01.

Current US energy policy includes many programs directed toward restructuring the energy system in order to decrease US dependence on foreign supplies and to increase our reliance on plentiful and environmentally benign energy forms. However, recent events have led to renewed concern over the direction of current energy policy. This study describes three possible energy strategies and analyzes each in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. In the first, no additional programs or policies are initiated beyond those currently in effect or announced. The second is directed toward reducing the growth in energy demand, i.e., energy conservation. The third promotes increased domestic supply through accelerated development of synthetic and unconventional fuels. The analysis focuses on the evaluation and comparison of these strategy alternatives with respect to their energy, economic, and environmental consequences. Results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial environmental benefits; the synfuels policy reduces imports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs and slows the rate of economic growth. These relationships could be different if the energy savings per unit cost for conservation are less than anticipated, or if the costs of synthetic fuels can be significantly lowered. Given these uncertainties, both conservation and RD and D support for synfuels should be included in future energy policy. However, between these policy alternatives, conservation appears to be the preferred strategy. The results of this study are presented in three reports (see also BNL—51105 and BNL—51128). 11 references, 3 figures, 61 tables.

36748 (CONF-790890—, pp C.31-C.37) **Foreign trade framework for the 1980's.** Piper, W.S. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

An overview of the Tokyo round of multilateral trade negotiations is given. Other topics discussed include: The Trade Agreements Act of 1979, trade reorganization as suggested by President Carter, solar trade prospects, and trade-export suggestions. (MHR)

36749 (CONF-790890—, pp C.65-C.66) **Institute for Scientific and Technological Coopration (ISTC): a brief explanation.** Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

This Institute was authorized as part of the Foreign Assistance Act. The purposes, program emphasis, special characteristics, relationship to AID, budget and staff, and public reactions are summarized briefly. (MHR)

36750 **American Indians and national energy policy.** Pendley, R.E.; Kolstad, C.D. *J. Energy Dev.;* **5**: No. 2, 221-251(Spr 1980).

The inter-tribal Council of Energy Resource Tribes (CERT) is bringing pressure to change the terms of energy development on Indian lands, which represent a significant share of domestic resources. The role of tribes in national energy policy is examined by reviewing tribal issues and concerns from a national, state, regional, and tribal perspective. The tribes generally view resources on their

lands as a one-time endowment which should be developed slowly, while the national view is for rapid development. Policies that ignore tribal resources or tribal concerns are inappropriate compared to cooperative and joint resolution of differences involving understanding and compromise on all sides. 29 references, 6 figures. (DCK)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 36001, 36740, 36754, 36892

36751 (FE—2468-81) **Research programs relevant to fossil-energy technology. Final report.** Conta, L.D. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Aug 1980. Contract AC01-77ET10679. 61p. NTIS, PC A04/MF A01.

The pace of energy-related R and D by government and non-government entities has accelerated greatly in recent years. Within the broad spectrum of R, D, and D activities, it is often difficult to adequately analyze the numerous programs to ensure effective interactions among programs. Effective interactions are necessary to improve the quality of individual programs, minimize redundancy, and eliminate gaps. This report is an overview of energy R, D, and D programs in government agencies, industry, and the professional societies as they appear to be of particular importance to the development of fossil-energy technologies. It is not an exhaustive examination of energy R, D, and D program details, but is illustrative of the diversity of programs and sponsoring organizations involved and points to the interrelationship of the research activities. A framework is provided upon which the potential for additional technology transfer and cooperative efforts can be examined.

COAL

REFER ALSO TO CITATION(S) 35937, 37084

PETROLEUM

REFER ALSO TO CITATION(S) 35957, 35977, 35978, 35979, 36852

36752 (DOE/EIA—0108(78)) **Crude petroleum, petroleum products, and natural gas liquids: 1978 (final summary).** (Department of Energy, Washington, DC (USA). Energy Information Administration). 19 Nov 1979. 38p. NTIS, PC A03/MF A01.

Production of crude petroleum (including lease condensate) in the United States in 1978 averaged 8,707,000 barrels per day, an increase of 5.6% above the 1977 level. Imports of crude oil in 1978 averaged 6,356,000 barrels per day, 3.9% lower than the previous year. Stocks of crude oil, both domestic and foreign, totaled 376,281,000 barrels at the end of 1978, 28.6 million barrels above the 1977 year-end level. The average value of crude oil at the wellhead in 1978 was $8.96 per barrel, an increase of $.39 per barrel above the 1977 average price. The number of oil wells completed in 1978 totaled 17,775 compared with 18,912 in 1977. Production of products at natural gas processing plants during 1978 totaled 1,567,000 barrels per day compared with 1,618,000 barrels per day during 1977. The stock level of products at natural gas processing plants, terminals and pipelines at the end of 1978 totaled 127,479,000 barrels, 2.0 million barrels below that of a year earlier. Total disposition of primary supply of all oils in 1978 averaged 19,224,000 barrels per day. Compared to 1977, total products supplied for domestic use increased by 416,000 barrels daily, or 2.3%. Of the major fuels supplied for domestic use in 1978, gasoline, jetfuel, and distillate fuel oil showed gains of 3.3%, 1.7%, and 2.4%, respectively, while residual fuel oil declined by 1.6%. Refined products stocks at the end of 1978 totaled 784,619,000 barrels, reflecting a stock decrease of 57.9 million barrels during the year. Thirty-two tables are presented dealing with the above mentioned items.

NATURAL GAS

REFER ALSO TO CITATION(S) 35977, 35978, 35986, 35987, 35990

36753 (DOE/EIA—0114(78)) **Sales of liquefied petroleum gases and ethane in 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 22 Oct 1979. 12p. NTIS, PC A02/MF A01.

Tables are presented on: sales of liquefied petroleum gases and ethane in the United States, 1974 to 1978; sales of liquefied petroleum gases and ethane by use, excluding use in gasoline production; sales of liquefied petroleum gases for residential and commercial use, by type; sales of liquefied petroleum gases for internal-combustion engine fuel, by type; sales of liquefied petroleum gases for industrial use; sales of liquefied petroleum gases for use as utility gas; sales of liquefied petroleum gases for miscellaneous uses; sales of liquefied petroleum gases and ethane for chemical use including synthetic rubber manufacture by type; and on liquefied petroleum gases exported from the United States, by countries.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 36012

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 36001, 36194

36754 **Accelerating synfuels development.** *EPRI J.;* **5**: No. 6, 25-27(Jul 1980).

The Energy Security Act of 1980 establishes a US Synthetic Fuels Corporation (USSFC) to oversee production, which will be financed by assistance to the private sector. The USSFC will function as a private financial institution, but will have a board of directors appointed by the president and approved by congress. The law establishes a 300-employee limit on the corporation and a $35 million ceiling on annual appropriations for administration. The functions, authority, and structure of the USSFC are summarized. Energy Security Act provisions also list initiatives to speed the development of other energy resources. (DCK)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 36638, 36639, 36735, 36828

36755 (ANL/SPG—7) **Appropriateness of a load-management agreement as the rate format for customer thermal storage: why a closeout sale on off-peak electricity should be adopted.** Nelson, S.H. (Argonne National Lab., IL (USA)). Mar 1980. Contract W-31-109-ENG-38. 34p. NTIS, PC A03/MF A01.

This report demonstrates why a load-management agreement is the best rate format for customer thermal energy storage (TES) from electricity. The first section presents the basic operating and cost characteristics of TES systems as well as potential problems that affect rate setting. Then, the criteria for choosing a rate structure are put forth, and the various rate formats available are analyzed considering the above information. Finally, the means of achieving the maximum social benefits using a load-management agreement are explored.

36756 (ANL/SPG—12) **Benefits and costs of load management: a technical assistance and resource material handbook.** (Argonne National Lab., IL (USA); Systems Control, Inc., Palo Alto, CA (USA); Gordian Associates, Inc., New York (USA); Temple, Barker and Sloane, Inc., Lexington, MA (USA)). Jun 1980. Contract W-31-109-ENG-38. 160p. NTIS, PC A08/MF A01.

This handbook will assist state regulatory authorities and electric utilities in complying with the Load Management Standard of the Public Utility Regulatory Policies Act of 1978. The handbook has two major sections. The first discusses load-management techniques in terms of equipment, customer applications, combinations of techniques, etc. Key steps for evaluating the costs and benefits of load management options also are presented. These steps are intended to sequentially eliminate ineffective load-management options as the cost-benefit calculation becomes more detailed. The second section includes up-to-date information on available load-management technologies, models for utility costing, load-management data transfer, prescreening of load-management options, and the load-management literature.

36757 (DOE/RA—0054) **Fourth annual program information notice.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications). Sep 1980. 99p. NTIS, PC A05/MF A01.

This notice informs interested organizations and individuals of the Office of Electric Energy System's (EES) progress in research and development. The EES program focuses on R, D, and D designed to produce benefits in support of national energy priorities of improvement in the efficiency of the electrical energy system (increased capacity utilization, decreased capital requirements, loss reduction, etc.); fuel shifting from oil and gas to more-abundant nonrenewable resources in the near term and to renewable resources in the long term; improved control over complex systems; successful integration of new energy sources (dispersed generation and storage) in meeting utility-customer needs; and enhanced environmental protection. The current EES Organization consists of three divisions: Power Delivery, System Architecture and Integration, and Generation and Storage Applications. The notice contains a synopsis of the major technical areas, subsequent summaries of the research projects under each area, and published reports resulting from past efforts.

36758 (DOE/RG/06428—01) **Techniques for analyzing the impacts of certain electric-utility ratemaking and regulatory-policy concepts. Glossary.** (Stone and Webster Management Consultants, Inc., New York (USA)). Aug 1980. Contract AC01-78RG06428. 109p. NTIS, PC A06/MF A01.

This document, Glossary, is the first in a series of reports to identify, describe, and apply techniques for analyzing the impacts of certain electric utility concepts. This report was developed with a focus on the currently evolving issues of ratemaking, especially as they might be expected to arise under Sections 101, 111, 113, 114, 131, 132, and 210 of the P.U.R.P.A. of 1978. Because the evolutionary process of ratemaking has led to multiple proceedings and changes of inference in some terms, the glossary attempts to delineate these changes where appropriate. Definitions not uniquely related to ratemaking are included if they are likely to be used in ratemaking proceedings. To avoid unnecessary duplication of effort and expense, the compilers relied heavily on previously developed, publicly available glossaries and definitions developed by organizations such as Edison Electric Institute, the Electric Power Research Institute, and the Institute of Electrical and Electronics Engineers. Existing definitions were revised and new ones were developed as appropriate.

36759 (DOE/RG/06428—02) **Techniques of analyzing the impacts of certain electric-utility ratemaking and regulatory-policy concepts. Bibliography.** (Stone and Webster Management Consultants, Inc., New York (USA)). Aug 1980. Contract AC01-78RG06428. 412p. NTIS, PC A18/MF A01.

This bibliography provides documentation for use by state public utility commissions and major nonregulated utilities in evaluating the applicability of a wide range of electric utility rate design and regulatory concepts in light of certain regulatory objectives. Part I, Utility Regulatory Objectives, contains 2084 citations on conservation of energy and capital; efficient use of facilities and resources; and equitable rates to electricity consumers. Part II, Rate Design Concepts, contains 1238 citations on time-of-day rates; seasonally-varying rates; cost-of-service rates; interruptible rates (including the accompanying use of load management techniques); declining block rates; and lifeline rates. Part III, Regulatory Concepts, contains 1282 references on restrictions on master metering; procedures for review of automatic adjustment clauses; prohibitions of rate or regulatory discrimination against solar, wind, or other small energy systems; treatment of advertising expenses; and procedures to protect ratepayers from abrupt termination of service.

36760 (DOE/RG/06428—03) **Techniques for analyzing the impacts of certain electric-utility ratemaking and regulatory-policy concepts. Regulatory laws and policies.** (Stone and Webster Management Consultants, Inc., New York (USA)). Aug 1980. Contract AC01-78RG06428. 310p. NTIS, PC A14/MF A01.

This report is a legal study prepared to provide a review of the substantive and procedural laws of each regulatory jurisdiction that may affect implementation of the PURPA standards, and to summarize the current state of consideration and implementation of policies and rate designs similar or identical to the PURPA standards by state regulatory agencies and nonregulated utilities. This report is divided into three sections. The first section, the Introduction, summarizes the standards promulgated by PURPA and the results of the legal study. The second section, State Regulatory Law and Procedure, summarizes for each state or other ratemaking jurisdiction: (1) general constitutional and statutory provisions affecting utility rates and conditions of service; (2) specific laws or decisions affecting policy or rate design issues covered by PURPA standards; and (3) statutes and decisions governing administrative procedures, including judicial review. A chart showing actions taken on the policy and rate design issues addressed by PURPA is also included for each jurisdiction, and citations to relevant authorities are presented for each standard. State statutes or decisions that specifically define a state standard similar or identical to a PURPA standard, or that refer to one of the three PURPA objectives, are noted. The third section, Nonregulated Electric Utilities, summarizes information available on nonregulated utilities, i.e., publicly or cooperatively owned utilities which are specifically exempted from state regulation by state law.

36761 (NP—25120) **Municipal and cooperative distributors of TVA power: 1979 operations.** (Tennessee Valley Authority, Knoxville (USA)). 1979. 72p. NTIS, PC A04/MF A01.

This is a report of the operations during the fiscal year ended June 30, 1979, of the 110 municipal and 50 cooperative electric systems that distribute TVA power to 2.7 million customers. The areas served by these locally owned distributors include 80,000 square mile in parts of seven states and have a population of well over 6 million. Data for this report were gathered by TVA from annual reports and other material prepared by each of these 160 distributors. TVA has reported its own power operations in its Power Annual Report for its fiscal year ending September 30, 1979. Specific information is presented on: sales, revenues and expenses, construction and capital financing, rates, earnings, energy conservation, load management, PURPA.

36762 **Mitigation of socio-economic impacts by electric utilities.** Metz, W.C. (Brookhaven National Lab., Upton, NY). *Public Util. Fortn.;* **106**: No. 6, 34-42(11 Sep 1980).

A compilation of measures taken by electric utilities for the mitigation of the social and economic impacts of major project construction shows the breadth and depth of current utility involvement in mitigation efforts, changing attitudes concerning utility responsibility in this area, and possible future public policies regarding such responsibility. Mitigation efforts are changing from the often one-sided single-item effort to legislative packages which spread revenues and taxes more equitably.

36763 **Regional analysis of electricity-demand growth.** Chern, W.S.; Just, R.E. (Oak Ridge National Lab, Tenn). *Energy (Oxford);* **5**: No. 1, 35-46(Jan 1980).

The model forecasts electricity demand and price by sector and by state. Econometric models are estimated for each of the nine census regions separately, using pooled time-series and cross-sectional (state) data. Thus, the estimated demand elasticities used in the forecasting model vary from region to region. The paper also presents and analyzes the most-recent forecasts for nine selected states. The results show that electricity-demand will continue to grow in all sectors and in all states. However, the rates of growth will be considerably lower than those observed in the 1950s and 1960s. Furthermore, the forecasted rates of growth in electricity demand vary considerably from state to state. The reasons for these variations being the different patterns of projected future growth in population, income, and industrial activities, as well as the different degrees of demand responsiveness to price changes among states. These regional variations of electricity demand growth suggest that forecasts at the national level should not be used as the basis for making energy policies at the regional or state level. 24 refs.

36764 **Pacific Northwest power generation, multi-purpose use of the Columbia River, and regional energy legislation: an overview.** Hittle, L. (Bonneville Power Administration, Portland, OR); Larson, S.; Randall, N.; Michie, P. *Environ. Law;* **10**: No. 2, 235-280(Win 1980).

Complex interrelationships and conflicts exist between the Columbia River Basin's hydroelectric resource and other existing or potential electric-energy resources, the development of new nonhydroelectric resources, and competing uses of the river system. The responsibilities of the US Army Corps of Engineers, the Water and Power Resources Services, and the Bonneville Power Administration are explained and analyzed as they relate to the region's power-planning problems and their effects on the operation of the Federal river projects. The Pacific Northwest Electric Power Planning and Conservation Act on the operation of the hydroelectric system and other uses of the basin's rivers offers an approach to coordinated regional energy planning that assures consideration of all potential conflicts. 187 references.

36765 **New look at small power plants: preface to the next four papers.** Ford, A. (Los Alamos Scientific Lab., NM). *Energy Syst. Policy;* **4**: No. 1-2, 25-36(1980).

A collection of small power plants may be able to deliver the equivalent amount of power that a large power plant can deliver, while leading to a lower price of electricity to consumers, fewer planning headaches for utilities, and reduced environmental impacts at and around plant sites. These findings should encourage utility planners and regulatory official to reexamine the small-plant alternative on a case-by-case basis. Methods and findings presented in four papers (abstracted separately) should be helpful to planners who choose to reevaluate small plants. It is emphasized that the findings presented in the four papers should not be transferred to a different region or a different utility system without careful study to ascertain whether the key assumptions employed in the analyses are relevant.

36766 **Economies of scale and reliability: the economics of large versus small generating units.** Loose, V.W.; Flaim, T. (Los Alamos Scientific Lab., NM). *Energy Syst. Policy;* **4**: No. 1-2, 37-56(1980).

The relative costs of large and small generating units are examined by taking into account both economies of scale and unit reliability. For the specific utility system considered, the higher reserve margin required for larger units outweighed their production-cost savings, while several smaller units resulted in lower costs to the utility. Recent studies on economies of scale in electricity generation and recent data on the performance of large units suggest that utilities should consider unit size in determining optimal-capacity-expansion plans. 21 references, 2 figures, 4 tables.

36767 **Defending against uncertainty in the electric-utility industry.** Ford, A. (Los Alamos Scientific Lab., NM); Yabroff, I.W. *Energy Syst. Policy;* **4**: No. 1-2, 57-98(1980).

Two strategies that utilities could follow in dealing with an uncertain future are analyzed, namely: (1) construction of small coal-

fired base-load plants rather than larger coal plants to take advantage of the shorter construction delay associated with the smaller plants; and (2) initiating an amount of construction of expensive, base-load capacity that is different from the amount indicated by the best demand forecast. These strategies are tested through the use of a computer-simulation model designed to mimic the way in which electric utilities expand generating capacity. The model simulates the planning, construction, and operation of coal-fired plants for base-load duty and turbine plants for peaking uses. By exercising the model so that electricity demand grows in an unpredictable fashion, the price penalties associated with under- or overinvestment in generating capacity are established. The effectiveness of the two strategies is measured by calculating the changes in the price penalty to the consumer. The paper concludes with specific recommendations that apply to those states in which construction work in progress is not allowed in the utilities' rate base. 24 references, 9 figures.

36768 Effect of demand uncertainty on the relative economics of electrical-generation technologies with differing lead times. Boyd, R. (Univ. of California, Davis); Thompson, R. *Energy Syst. Policy;* **4**: No. 1-2, 99-124(1980).

Projections of future electricity demand are subject to considerable uncertainty. Because the demand depends on factors such as population and economic growth - the more distant the time period for which the projection is made, the greater is the uncertainty. Thus, generation technologies with different lead times face demand forecasts with different levels of uncertainty. This fact affects the relative economics of generation technologies with differing lead times. A model is described in which a stylized electric utility faces the decision between a short- and a long-lead-time technology in an uncertain environment. A dynamic-programming algorithm is used to determine the least-cost investment decision. It is shown that uncertainty can lead to the choice of some short-lead-time capacity, even when the deterministic solution includes only long-lead-time capacity. The extent of this effect depends on the nature of the probability distribution of future demands and the relative fuel and capital costs of the two technologies. 9 references, 7 figures.

36769 Analyzing load-management options for the Pacific Northwest. Timm, R.J. (Univ of Wisconsin, Madison). *Therm. Power Conf. Proc.;* 101-119(1978).

There is considerable disagreement as to future electrical loads and the impact of conservation and alternate energy programs. Construction costs of thermal electric-generating facilities have escalated at unprecedented rates. The future allocation of energy from Federally owned and operated facilities is essentially unknown. Fuel costs have escalated and, in some cases, changed the relative economics of alternate generating sources. Licensing procedures have become arduous because of an inability to develop a consensus on energy forecasts and long range plans. 25 refs.

36770 (NP—25124) **Assured power supply and electricity rates based on the actual costs.** (Deutsche Verbundgesellschaft e.V., Heidelberg (Germany, F.R.); Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (Germany, F.R.)). [nd]. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01.

According to the electric power industry, any state regulation forcing utilities to tolerate the use of their supply network by other suppliers would not enhance competition in favor of all consumers - it would only bring a short-term advantage to some of the major consumers. At the same time, supply assurance would be endangered, an un-social pricing policy would be instigated, and the power supply industry would be concentrated in a manner adverse to competition. According to this, fixed supply territories are still a basic precondition for an assured and profitable electric power supply.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 36208, 36209, 36751

36771 (EPRI-NP—1520) **Basic national data system for power plants.** Cleveland, E.B.; Gauger, R.H.; Hall, S.C.; Thurkow, T.J.; Koppe, R.H.; Keller, R.W.; Fedie, M.L. (Holmes and Narver, Inc., Orange, CA (USA); Stoller (S.M.) Corp., Boulder, CO (USA)). Sep 1980. 85p. NTIS, PC A05/MF A01.

This report defines the scope of data requirements for a proposed National Data System. Needs of the electric-power industry for plant- and equipment-performance data to support critical decisions are defined. These decisions are in the areas of system planning, design of new power plants, operating-plant performance, and equipment improvements. Various indices and descriptive combinations are defined to translate these data needs into data-element requirements. The scope of the data element requirements are categorized as Design (Pedigree) Data, Unit Performance Data, Outage and Derating Data, and Component Data. Recognizing the variability in system and unit size, an optimum level of data reporting is defined. This is accomplished in a manner that provides the widest range of data on a national basis while minimizing the impact upon individual utilities. The scope of data requirements described may be considered to be cost-effective.

36772 Formal evaluation of large and small power stations in southeastern Utah. Ford, A. (Los Alamos Scientific Lab., NM); Champion, D.; Gardiner, P. *Energy Syst. Policy;* **4**: No. 1-2, 125-155(1980).

The environmental impacts from large and small power plants are explained. Of particular interest are the social and economic changes in the small towns likely to experience boom-town growth during plant construction; the health and safety effects arising from coal mining, transportation, and combustion; the effect of transferring water from irrigated agriculture to power plant cooling; and the effect of plant operation on the atmospheric visibility in the nearby national parks. Multi-attribute utility measurement provides a formal evaluation of the diverse set of impacts arising from the large and small power plants. Value information obtained from a workshop with eight residents of the region is used to identify which of the many impacts appear most crucial to the comparison of large versus small plants. 20 references, 10 figures, 3 tables.

36773 Production-cost simulation model for the PNW electrical system. Hassoun, H. (DOE, Salem, Oreg). *Therm. Power Conf. Proc.;* 193-202(1978).

The basic objective of a production-cost model is to determine the operating cost of an electricity-generation system. This is accomplished by simulating the operation of the system in meeting a given level and shape of demand. Although production-cost models are used for several purposes, the most-important application is for generation planning - usually in combination with a reliability model and an investment costing model. The focus of this paper is on the Oregon Department of Energy production-cost model. The model was developed over a period of two years. Although the model was developed internally by the Department's staff, some regional institutions contributed to its development in one form or another. These include the BPA's Branch of Power Resources, the Coordinating Group of the Northwest Power Pool and the North Pacific Division of the Corps of Engineers. 3 refs.

36774 Environmental concerns of power generation. Coleman, J.A. (DOE, Washington, DC). *Therm. Power Conf. Proc.;* 149-163(1978).

In the siting of power generation and -transmission facilities and the development of new energy technologies, not only do environmental standards have to be met, but potential consequences for environmental concerns should be examined closely for those potential emissions of pollutants for which standards have not yet been established. New energy systems should be designed so as to meet future environmental standards, not just the standards that were in place at the time that these systems were developed. This is sometimes difficult because one is trying to predict the future environmental regulatory climate and also trying to promote efficient energy systems that will be able to meet future standards. In this paper, the author touches on one of the ways used to make these predictions and examines the potential environmental impacts of energy systems throughout the nation. 7 refs.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 36810, 36820, 36824, 36829, 36834, 36835, 36838, 36841

36775 Relationship between energy and GNP: a reexamination. Akarca, A.T.; Long, T.V. II. (Univ. of Chicago, IL). *J. Energy Dev.;* **5**: No. 2, 326-331(Spr 1980).

The causal relationship which Kraft and Kraft, Chow and Fisher, Sims and others identify for gross energy consumption (GEC) and gross national product (GNP) is challenged. At issue is the significance of data during periods of war and the discrepency between observed variables and the time delay from cause to effect. No solution is advanced for determining causal relationship. 14 references, 3 tables. (DCK)

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 36892

36776 (CONF-790890—, pp C.25-C.27) **Factors affecting US solar trade with Brazil.** Asin, J. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The following topics are discussed: energy background, surveying alternative sources of energy, identifying sectors for potential use of solar/wind technologies, primary consideration affecting US exports to Brazil, and by considerations for US companies. (MHR)

36777 (CONF-791251—) **Research planning workshop on energy for rural development.** (Indian Inst. of Management, Ahmedabad). 1979. 258p. NTIS (US Sales Only), PC A12/MF A01.

From Research planning workshop on energy for rural development; Ahmedabad, India (27 Dec 1979).

The Research Planning Workshop was conducted to develop an integrated need-based research and implementation program consisting of projects for energy supply in rural areas of India, with emphasis on renewable sources, which can be implemented in 2 to 3 years. Many papers were presented in the following sessions: Rural Energy Demand Supply Data Base Development (3 papers); Introduction to New and Renewable Energy Technologies in Rural Energy Mix I (solar technology and integrated rural energy centers, (4 papers); Introduction to New and Renewable Energy Technologies in Rural Energy Mix II (biogas plants, 5 papers); Fuel Plantation for Rural Areas (3 papers); Techno-Economic Analysis of Rural Energy Systems (2 papers); and Energy Policy for Rural Areas and Development Strategy (2 papers).

36778 (NP—25005) **Nonconventional sources of energy: notes on short-term course.** Mudgal, A.G. (comp.). (Indian Inst. of Tech., Bombay). 1980. 387p. NTIS (US Sales Only), PC A17/MF A01.

A separate abstract was prepared for each of the 27 presentations. All will appear in the DOE Energy Data Base (EDB); seventeen were selected for Energy Research Abstracts (ERA); and eight were selected for Energy Abstracts for Policy Analysis (EAPA).

SOLAR

REFER ALSO TO CITATION(S) 36215, 36216, 36217, 36220, 36221, 36222, 36223, 36224, 36225, 36226, 36227, 36228, 36229, 36230, 36233, 36234, 36293, 36382, 36457, 36471, 36476, 36720, 36865

36779 (CONF-790890—, pp C.93-C.107) **Opportunities for solar energy products and technology in Egypt.** Cooper, J.S. Oct 1979.

From Solar export issues workshop; Bethesda, MD, USA (12 Aug 1979).

The setting for an energy assessment in Egypt is presented; what was done in this assessment is explained briefly; and the principal insight which can be drawn from it are summarized. (MHR)

36780 (CONF-800491—, pp 556-557) **Problems and prospects for an SPS role in New York State's energy future: a major case study of concept viability.** Sviedrys, R.; McHugh, D.; Homatas, G. (Polytechnic Inst. of New York, Brooklyn). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

GEOTHERMAL

REFER ALSO TO CITATION(S) 36540, 36541, 36542, 36546

OTHER

REFER ALSO TO CITATION(S) 36206, 36326, 36327, 36331, 36582, 36854

DIRECT ENERGY CONVERSION

DIRECT ENERGY CONVERSION

REFER ALSO TO CITATION(S) 36778

MHD GENERATORS

36781 (DOE/ET/10815—46) **MHD Coal-Fired Flow Facility. Quarterly/annual technical progress report, October-December 1979.** Dicks, J.B.; Chapman, J.N.; Crawford, L.W. (Tennessee Univ., Tullahoma (USA). Space Inst.). Feb 1980. Contract AC02-79ET10815; AC01-76ET10757. 68p. NTIS, PC A04/MF A01.

In this Fourth Quarterly/Annual Report submitted under DOE contracts EX-76-C-01-1760 and DE-AC02-79ET10815, the University of Tennessee Space Institute (UTSI) reports on significant activity, task status, planned research, testing, and development, and conclusions for the Magnetohydrodynamics (MHD) Coal-Fired Flow Facility (CFFF) and the Research and Development Laboratory. Work on the CFFF progressed with only minor problems. Total construction activity for all site work presently awarded is nearly 98% complete. Water analysis shows that Woods Reservoir baseline conditions are within EPA or Tennessee drinking water standards. For the primary combustor, the vitiation heater and primary combustor fabrication drawings were completed and the nozzle design was completed. The drum module for the radiant slagging furnace was awarded. On the MHD Power Generator, development continued in several areas of advanced analysis including development of time-dependent models for use with the one-dimensional code. For seed regeneration, the tentative determination is that the Tomlinson Tampella is the most economically viable method. With regard to capped electrode erosion, investigations have shown that the major degradation of the cladding still present is at the leading edge of the capped anode. To alleviate this, plans are to hot work the noble metal in the bending operation. In resolving another problem, a system employing the modified line-reversal method has been assembled and successfully tested to measure absolute plasma temperatures.

36782 (DOE/ET/10816—T1(Vol.1)) **MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.** (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 1978. Contract AC07-78ET10816. 305p. NTIS, PC A14/MF A01.

Separate abstracts were prepared for the seven sections included in this volume. (WHK)

36783 (DOE/ET/10816—T1(Vol.1), pp 276-283) **MHD siting and environmental screening.** Chaffee, J. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Utilizing the experience gained in previous MHD siting studies and the current literature, an MHD siting methodology has been formulated to aid in locating facilities such as the Engineering Test Facility (ETF). In support of this document, a socioeconomic impact assessment methodology and a computer siting capability are being developed. The combination of these three documents should result in a comprehensive siting package that is highly versatile and readily applicable to both MHD and conventional facilities.

36784 (DOE/ET/10816—T1(Vol.1), pp 284-303) **Environmental analysis of trace elements and submicron particles from MHD test facilities.** Egan, N.; Moody, B.; Runnion, K.; Huddleston, G.; Lundberg, S. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

The sampling, analysis, and computer modeling of trace elements and submicron particle emissions will allow these emissions to be characterized and possible control methods to be identified. Samples have been taken from the University of Tennessee Space Institute (UTSI) and TRW, Incorporated; analysis shows element partitioning in both facilities, and element enrichment was evident in three samples taken previously from the Pittsburgh Energy Research Center (PERC). A computer model has been written for a quench system, and the chemical equilibrium model was run successfully with data from three sources. A subcontract was let to Spectron Development Laboratories to define laser measurement systems for in situ use at MHD facilities. An RFP was issued for the design, fabrication, and calibration of a high-temperature extractive sampler. Bulk analysis has been subcontracted to the Environmental Trace Substances Research Center (ETSRC). Inductively coupled plasma (ICP) emission and instrumental neutron activation analysis (INAA) were employed. Surface analysis was subcontracted to Montana State University (MSU). MSU utilized a scanning electron microscope with an x-ray fluorescence attachment to analyze samples. Two methods of analysis were employed: single element mapping and complete elemental analysis of a spot or region. Work has continued on computer modeling to assess possible NO/sub x/ emissions from the Component Development and Integration Facility (CDIF). The MHDAV program was modified to enable gas flow simulation of an Engineering Test Facility (ETF) design provided by AVCO Everett Research Laboratories, and results from the chemical equilibrium program were compared to other similar programs.

36785 (DOE/ET/10816—T1(Vol.2)) **MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.** (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 1978. Contract AC07-78ET10816. 258p. NTIS, PC A12/MF A01.

Separate abstracts were prepared for the six sections in this volume. (WHK)

36786 **Magnetohydrodynamic power generation: program planning and status.** Jackson, W.D.; Levi, E. (US DOE, Washington, DC). *IEEE Trans. Power Appar. Syst.;* **PAS-98**: No. 6, 2022-2029(Nov-Dec 1979).

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 36792

36787 (DOE/ET/10816—T1(Vol.2), pp 306-344) **Slag flow and NO/sub x/ kinetics: moderate temperature slag flow facility (MTSFF).** Townes, H.W.; Reihman, T.C. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

The moderate temperature slag flow facility (MTSFF) has been operated for over 1150 hours with slag in the combustion air stream. A determination has been made of the effect of particulate size on the rate of pressure drop increase and of the effect of slag on long-term (750 hours) operation of the facility. Plots or tables of temperatures, flow rates, pressure drops, particulate size, and Reynolds numbers for the test conditions during four runs totaling 1150 hours of operation are included.

36788 (DOE/ET/10816—T1(Vol.2), pp 498-542) **Cycle analysis and control.** Pierre, D.A.; Rudberg, D.A.; Dudding, C.H. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Combined-cycle MHD-steam power systems are being modeled by digital computer simulations. Methods to provide efficient control of such systems are being investigated by using the simulations to ensure stable modes of response and to obtain coordinated control of many interdependent sub-systems. Methods for forming dynamic component models are being developed, as is a multi-input, multi-output model of the combustor, nozzle, channel, and diffuser. First-principle dynamic models of plant components are being embedded in the latest simulation. Progress is reported.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 36787, 36792

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 35899, 35900, 35928, 36788

36789 (AD-A—079551/8) **Explosive MHD research. Final report 1 apr 76-31 mar 77.** Gill, S.P.; Baum, D.W.; Shimmin, W.L.; Mukherjee, D. (Artec Associates, Inc., Hayward, CA (USA)). 31 May 1977. Contract N00014-75-C-0822. 125p. NTIS, PC A06/MF A01.

Research on dense nonideal plasmas used in explosive MHD pulse power generators is described. Experiments were performed with three types of explosive plasma sources producing a plasma pressure about 10 kbar and a plasma temperature about 5 eV (58,000 K). A literature survey was performed on theoretical methods for predicting the properties of nonideal plasmas, and calculations were performed using some of the models. Encouraging progress was made in reducing a discrepancy between theory and experiment.

36790 (ANL/MHD—79-17) **Technical support for open-cycle MHD program. Progress report, January-June 1979.** Bomkamp, D.H. (ed.). (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 94p. NTIS, PC A05/MF A01.

The support program for open-cycle MHD at the Argonne National Laboratory consists of developing the analytical tools needed for investigation of the performance of the major components in the combined-cycle MHD/steam power system. The analytical effort is centered on the primary components of the system that are unique to MHD and, also, on the integration of these analytical models into a model of the entire power-producing system. The present project activities include modeling of the combustor, generator, seed deposition, and formation and decomposition of NO. Parametric studies were performed to evaluate the performance of the U-25B generator and to support the design of the US U-25B generator. Refinements and improvements to the MHD systems code and executive program are described.

36791 (ANL/MHD—80-1) **MHD heat and seed recovery technology project. Eighth quarterly report, October-December 1979.** Petrick, M.; Johnson, T.R. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01.

The MHD Heat and Seed Recovery Technology Project at Argonne National Laboratory is obtaining information for the design and operation of the steam plant downstream of the MHD channel-diffuser, and of the seed regeneration process. The project goal is to supply the engineering data required in the design of components for prototype and demonstration MHD facilities. The work is being done in close cooperation with the Heat Recovery-Seed Recovery facilities, which will be 20-MW prototypes of the MHD steam bottoming system. The primary effort of the HSR Technology Project is directed toward experimental investigations of critical issues, such as (1) NO/sub x/ behavior in the radiant boiler and secondary combustor; (2) radiant boiler design to meet the multiple requirements of steam generation, NO/sub x/ decomposition, and seed-slag separation; (3) effects of solid or liquid seed deposits on heat transfer and gas flow in the steam and air heaters; (4) formation, growth, and deposition of the seed-slag particles; (5) character of the combustion gas effluents; and (6) the corrosion and erosion of ceramic and metallic materials of construction. These investigations are performed primarily in a 2-MW test facility, Argonne MHD Process Engineering Laboratory (AMPEL). Other project activities are related to studies of the thermochemistry of the seed-slag combustion gas system. Activities are reported.

36792 (COO—4049-17) **DOE/PETC 5MW two-stage MHD pressurized coal combustor: operation, maintenance, and modification. Quarterly activity report, April 1, 1980-June 30, 1980.** Owoc, H.J. (Management and Technical Services Co., Philadelphia, PA (USA)). 25 Jul 1980. Contract AM02-76PC04049. 19p. NTIS, PC A02/MF A01.

During this period, eight (8) combustor test runs were attempted, with the AVCO-designed MHD plasma Diagnostic Test Section (DTS) installed downstream of the combustor to measure the temperature and conductivity of the plasma and slag and to observe slag flow patterns and accumulation. Various insulating materials were installed between the fifty (50) copper plate electrodes, which comprise the bulk conductivity section of the DTS, to ascertain which material provided the highest electrical resistance. Obtaining accurate and meaningful resistance readings from the bulk conductivity units was complicated by the current leakage problems which developed from electrode to electrode, caused by the conducting rubber cooling water hoses supplied with the DTS by AVCO, and the moisture, seed and slag which penetrated the insulation between the plates during normal operation. The MATSCO/GE modifications to correct the DTS seal leakage and restraint problems, discussed in the previous two quarterly reports, were successful, since the DTS has subsequently operated through thirteen (13) tests without a recurrence of the problems. In addition, numerous equipment and operational improvements were made to the combustor and its support systems this quarter to make operation and maintenance more controllable, reliable, and safe.

36793 (DOE/ET/10816—T1(Vol.1), pp 195-275) **Materials evaluation and management of university and MERDI supporting science and technology.** Rasmussen, J.J. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Development of powder preparation and sintering procedures for fabricating magnesia/magnesia-alumina spinel hardware and test pieces formed by isostatic pressing, slip-casting, and extrusion are reported. Several commercially available binders and other ceramic fabrication aids were evaluated. Characterization of degradation in commercial refractories and technical ceramics exposed to simulated coal-fired MHD preheater operating conditions is reported. Measurements of changes in the thermal diffusivity are related to microstructural and mechanical properties degradation. Pristine RFG, a rebonded fused-grain magnesite chrome refractory used as the core material in the Montana State University (MSU) preheater test facility, degraded substantially when thermally cycled between 1040 to 1180°C and 1300 to 1400°C ranges for up to 7000 cycles in air. Pristine X317, a commercial fused-cast magnesia/magnesia-alumina spinel, was cycled through four consecutive heating-cooling cycles from room temperature to 1100°C. The thermal diffusivity displayed large reproducible hysteresis loops which are attributed to the shrinking and separation of primary periclase within the spinel matrix - a type of microcracking. Analysis of optical and scanning electron micrographs confirms this conclusion. The thermal conductivity/diffusivity of high-purity, dense, polycrystalline, magnesia-rich magnesia-alumina spinels is shown to depend primarily on the excess amount of high-conductivity magnesia phase. The thermal diffusivity equipment was upgraded by the addition of a low-temperature thermocouple and a high-temperature photodiode transient temperature detector. The wetting behavior of molten Rosebud coal slag with a series of dense, high-purity, $MgO/MgAl_2O_4$ composites with compositions varying in excess MgO from 0 to 86 m/o, was studied.

36794 (DOE/ET/10816—T1(Vol.2), pp 493-497) **MHD instrumentation and data acquisition.** Johnson, R. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Two computer models for the purpose of simulating MHD dynamic coal combustor performance currently are being evaluated. A model based upon the cycle analysis and control plug flow combustor model is being coded for the inclusion of devolatization dynamics and to provide steady-state initial input boundary conditions for a more general dynamic model. Based upon the impulse response of the Navier-Stokes equations, a more general model also is under development. Graphical routines have been incorporated into the general steady-state design/analysis program for the MHD topping cycle and the separate dynamic steam bottoming plant including heat capacitor. All components necessary for a bench-

scale, two-pole generalized inverter model have been received and tested with the exception of some capacitors.

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 36790, 37303

36795 (DOE/ET/10816—T1(Vol.2), pp 345-470) **Slag-seed equilibria and separations related to the MHD system.** Howald, R.; Eliezer, I.; Woodriff, R.; Eliezer, N.; Puligandla, V. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

The objective of this task is the measurement and interpretation of vapor pressures over high-temperature oxide systems and the thermodynamic analysis of these systems. The systems under study are primarily synthetic mixtures, actual slags, and seeded slags. The measurements are performed by using atomic absorption to measure atom concentration produced by diffusion from vapor pressure cells in high-temperature graphite tube furnaces (Woodriff furnaces). The interpretation is designed to provide accurate equations for vapor pressure and activity in multi-component systems for use in engineering design work where slags are encountered in MHD. Measurements of potassium vapor pressure over model slag ternary and quaternary systems are continuing, and a substantial effect of calcium oxide content on the potassium vapor pressure has been identified. Composition-temperature-equilibrium-activity correlations have been developed for several binary and ternary slag-related mixed oxide systems. Five papers based on these results which have been published are included. (WHK)

36796 (DOE/ET/10816—T1(Vol.2), pp 471-492) **Physical properties of coal slag and electrode materials: thermionic emission and effects of electrical conduction.** Lapeyre, G.; Anderson, J. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Thermionic emission measurements were made on five six component synthetic slags containing from zero to 30% K_2O. The effective work function, phi/sub e/, was found to be dependent on temperature and on the presence or absence of potassium. For the slag without potassium, phi/sub e/ varied from 4.3 eV to about 5.1 eV over the temperature range 1400 K to 1700 K. For the slags with added potassium, phi/sub e/ generally varied from 3.2 eV at 1100 K to about 4.0 eV at 1600 K. The slags with the higher potassium content appeared to have a somewhat lower phi/sub e/ at the higher temperatures than those with smaller amounts of potassium. X-ray fluorescence measurements showed that the slag samples lost appreciable amounts of potassium at the higher measuring temperatures. Slag measurements at higher background pressures, up to one torr, of argon and oxygen showed that the argon reduced the emission current only slightly. The emission current recovered when the argon was removed. Oxygen apparently produced a permanent effect on the surface chemistry of the slag because the emission was reduced by more than two orders of magnitude and did not recover when the oxygen was removed. The thermionic emission of strontium-doped lanthanum chromite was measured over the temperature range 1300 K to 1800 K and found to be 3.28 +- 0.08 eV. Preliminary electrolysis experiments were carried out on samples of synthetic coal slag. X-ray fluorescence measurements showed a motion of cations toward the negative electrode when current was passed through the slag at a temperature of 1000°C.

36797 (DOE/ET/10816—T1(Vol.2), pp 543-561) **Slag physical properties: electrical and thermal conductivity.** Pollina, R. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Electrical conductivity data for seeded and unseeded coal slags from eastern, mid-western, and western coals are presented. Above approximately 1675 K, the composition differences between these slags have little effect on electrical conductivity, a fact which is significant for generator operation. Below about 1400 K, large differences in electrical conductivity are observed which can be explained in part by differences in their composition. Data are presented for Rosebud ash electrical conductivity as a function of seed content to 1723 K. Again, seed content has only a small effect on conductivity at high temperatures. Calculations of slag surface layer conductivity were done for the Faraday direction (normal to the slag layer) and for the Hall direction (interelectrode gap resistance). For metal electrodes, these were determined by the metal-slag and slag-plasma interface temperatures, respectively. These calculations agree with slag layer measurements at AVCO. The thermal expansion of vitreous, natural Rosebud ash was measured and found to be 6.4 +-0.3 x $10^{-6}K^{-1}$ between 300 and 95 K. In its crystalline form, an increase of 11% in the thermal expansion was evidenced.

THERMOELECTRIC GENERATORS

MATERIALS, COMPONENTS, AND AUXILIARIES

36798 (SERI/TP—731-756) **Thermoelectric properties of bismuth-antimony thin films.** Treffny, J.; Jayadev, T.S. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 6p. (CONF-800806—39). NTIS, PC A02/MF A01.

From 15. intersociety energy conversion engineering conference; Seattle, WA, USA (18 Aug 1980).

Thermoelectrics have a wide range of potential applications in the temperature range of 0° to 100°C. In an effort to enhance the feasibility of thermoelectrics, we have begun investigation of potentially cheaper materials and cheaper techniques for thermoelectrics. Two features of bismuth and antimony have influenced our work. First, Horst and Williams have reported quite respectable figure of merit values in bulk single crystals of bismuth-antimony, up to 2.5 x 10^{-3} at room temperature. Second, bismuth and antimony are an order of magnitude cheaper in cost compared to selenium and tellurium, making this binary alloy a natural candidate to reduce the cost of thermoelectric devices. Our avenue of approach involves a simplification of the fabrication process using an established technique of solid-state electronics: thin-film deposition. We have recently begun to investigate the extent to which the favorable properties of bulk Bi-Sb are preserved in thin films. Some of the preliminary data coming out of this ongoing investigation are reported.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

36799 (TE—4258-290-80(DRAFT)) **Formation of double sheaths and the J-V characteristics of the obstructed region.** Wang, C.C. (Thermo Electron Corp., Waltham, MA (USA)). Jun 1980. Contract AC02-76ET11293. 33p. NTIS, PC A03/MF A01.

The arc drop of the vapor thermionic converter is determined by the difference of sheath heights and the potential difference across the plasma. The J-V characteristics of cesium vapor diodes operating in the ignited mode show a knee corresponding to near optimum power. When the diode is operating in the region above the knee, the dominant contributor to the arc drop is the difference of the sheath heights (i.e., the potential difference across the plasma produces either a very small loss or may, in fact, reverse sign and reduce the arc drop). In this region the power decreases because the increase in output current is usually not able to compensate for the loss of output voltage. When the diode is operating in the region below the knee, the potential difference in the plasma becomes the dominant contributor to the arc drop. For these reasons, the shape of the J-V characteristics below the knee is different from that above the knee. The location of the knee is a good indicator of the maximum power and the maximum efficiency points. Under the fully optimized conditions, the knee also indicates the barrier index of the diode. Therefore, how and where the knee will appear is of great theoretical and practical interest. Some workers in the thermionic field have speculated that the appearance of the knee is due to the formation of the double sheath. However, this study indicates that the formation of the double sheath takes place significantly below the knee. In addition, this study evaluates J-V characteristics in the obstructed region.

36800 (TE—4258/4247-126-80) **DOE/JPL Advanced Thermionic Technology Program. Progress report No. 41.** (Thermo Electron Corp., Waltham, MA (USA)). Dec 1979. Contract AC02-76ET11292. 81p. NTIS, PC A05/MF A01.

The primary long-term goal of the DOE effort is to improve TEC performance to the level that thermionic topping of fossil fuel steam powerplants becomes technically possible and economically attractive. An intermediate goal is to demonstrate an in-boiler thermionic module in the early 1980's. A short-term goal is the demonstration of the reliability of thermionic operation in a combustion environment. The focus of the JPL program is to develop thermionic conversion technology appropriate for nuclear electric propulsion (NEP) missions. These missions require operation at collector temperatures substantially higher than those associated with terrestrial applications. The DOE and JPL tasks for developing thermionic energy conversion (TEC) are complementary and synergistic. Converter performance improvement is an area in which one agency's program supports the effort of the other. Progress in the DOE program is reported including: (1) demonstration of over 3600 hours of stable operation (Quarter Scale Silicon Carbide Converter No. 1) in a combustion environment at emitter temperatures at, or above, 1600°K; (2) calculation of a complete current density-voltage characteristics in the power quadrant which includes both double valued sheath effects at the emitter and the spatial distribution of electron temperature in the interelectrode plasma; and (3) successful operation of Converter No. 222 with a cesium-graphite reservoir.

JPL program accomplishments reported include: (1) performance data have been obtained on three planar variable spaced converters with molybdenum emitters (Converter Nos. 223, 227 and 228); and (2) system calculations indicate that long term thermionic performance demonstrated at Thermo Electron should yield a power system specific mass less than 22 kg/kWe.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 36800

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 36800

FUEL CELLS

DESIGN AND DEVELOPMENT

36801 (DOE/ET/17019—2) **Development of molten carbonate fuel cell power plant. Quarterly technical progress report, May 1-July 31, 1980.** Peterson, J.R. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 4 Sep 1980. Contract AC02-80ET17019. 172p. NTIS, PC A08/MF A01.

The major objective of this program for development of a molten carbonate fuel cell power plant is to establish and demonstrate readiness for fabrication and test of full-scale prototype stacks. This will be accomplished by a heavy emphasis upon resolution of remaining technology problems, including materials, processes and contaminant effects research, development and testing of cell components to 10,000 hours endurance life and scaleup of laboratory hardware to commercial size. A detailed design for a prototype stack will be defined and a tenth-size of full-scale cells will be tested. Component and manufacturing processes will be developed based upon commercial cost goals. Coal-fired utility central station and industrial cogeneration power plant requirements will be defined and plant options evaluated, leading to selection of a single reference design. Cell and stack design and development will be guided by requirements based upon the reference plant design. The specific program objectives derived from the contract work statement are as follows: (1) to define a reference power plant design for a coal-fired molten carbonate power plant; (2) to develop and verify cell and stack design based upon the requirements of the reference power plant design; (3) to establish and demonstrate readiness to fabricate and test full-length stacks of full-scale cells, hereafter called prototype stacks; and (4) to quantify contaminant effects and establish a program to verify performance of molten carbonate fuel cells operating on products of coal gasification. Progress is reported.

36802 (DOE/PE—03871-01, pp 16.1-16.14) **Fuel cells.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The status of the development and utilization of fuel cells is reviewed. Fuel cell operation, performance, and economics are discussed. (WHK)

36803 (HN—1540) **Feasibility study: fuel cell cogeneration at the Anheuser-Busch Los Angeles brewery.** Banister, R.M.; Corea, V.A.; Sorensen, J.C.; Duncan, J.M.; Rudawitz, L.; Verdes, R. (Holmes and Narver, Inc., Orange, CA (USA)). Feb 1980. Contract AC03-78CS40226. 246p. NTIS, PC A11/MF A01.

The results of a feasibility study undertaken in support of the overall Department of Energy (DOE) goal to develop fuel cell power plants for industrial cogeneration are described. Use of a single 4.5 MW fuel cell power plant like that manufactured by United Technologies Corporation (UTC) and currently being constructed on the Consolidated Edison of New York System was examined. The technical feasibility of using such a plant in a cogeneration mode at the Anheuser-Busch, Los Angeles brewery was affirmed by the study. Break-even capital costs for UTC supplied equipment were calculated for various conditions. Based upon the assumption that UTC supplied equipment could be provided for the $350 to $400/kW projected for first generation fuel cells, the economic feasibility of fuel cell cogeneration was demonstrated for nearly all assumed conditions. The most economical case was found to be a municipal utility owned, base loaded power plant where economic credit is taken for reduced environmental emissions. Acceptable fuels were evaluated for their availability, and the fuels identified for use were natural gas with propane as a backup. Phosphoric acid is the selected electrolyte. The Demonstration Program Plan is described. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 36801

36804 (FCR—0926(Vol.1)) **Evaluation of battery converters based on 4.8-MW fuel cell demonstrator inverter. Final report.** Kornbrust, F.J.; Vivirito, J.R.; Walton, J.W.; King, J.M. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1978. Contract AC01-76ET26961. 228p. NTIS, PC A11/MF A01.

Electrical power conditioning is a critical element in the development of advanced electrochemical energy storage systems. This program evaluates the use of existing self-commutated converter technology (as developed by the Power Systems Division of United Technologies for the 4.8-MW Fuel Cell Demonstrator) with modification for use in battery energy storage systems. The program consists of three parts: evaluation of the cost and performance of a self-commutated converter modified to maintain production commonality between battery and fuel cell power conditioners; demonstration of the principal characteristics required for the battery application in MW-scale hardware; and investigation of the technical requirements of operation isolated from the utility system. A power-conditioning system consisting of a self-commutated converter augmented with a phase-controlled rectifier was selected and a preliminary design prepared. A principal factor in this selection was production commonality with the fuel cell inverter system. Additional types of augmentation, and the use of a self-commutated converter system without augmentation, were also considered. A survey of advanced battery manufacturers was used to establish the dc interface characteristics. The principal characteristics of self-commutated converter operation required for battery application were demonstrated using an available 0.5-MW development system. A survey of five REA and municipal utilities and three A and E firms was conducted to determine technical requirements for operation in a mode isolated from the utility. Definitive requirements for this application were not established because of the limited scope of this study.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 36738

36805 (DOE/ET/20475—T1) **Energy Conservation: Program Summary Document, FY 1981.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Feb 1980. Contract AC01-78ET20475. 285p. NTIS, PC A13/MF A01.

An overview is presented of the Energy Conservation Programs being implemented by the Office of the Assistant Secretary for Conservation and Solar Energy in DOE. This document together with the Solar Energy and Energy Storage Program Summary Documents covers all programs of the Office of Assistant Secretary for Conservation and Solar Energy. Consistent with the FY 1981 budget, conservation objectives, Federal strategy, impacts, and issues are presented in this document for the following programs: buildings and community systems; industrial energy conservation; transportation; state and local; multi-sector appropriate technology; energy inventions; energy conversion technology; energy information campaign; and energy impact assistance. The principal purposes of this document are to provide an Energy Conservation reference book for Congress and to disseminate information to the general public. Chapter I contains an Introduction and FY 1981 Budget Summary. Chapter II contains an Overview of Energy Conservation. The remaining chapters provide information on individual programs.

36806 **Changing energy-use futures: international conference on energy-use management, 2nd, volume 1 through 4, 1979.** Fazzolare, R.A. (ed.); Smith, C.B. (ed.). New York, NY; Pergamon Press (1979). 2306p. (CONF-791009—).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This conference contains 290 papers, which are abstracted separately and which are published in four volumes. The topics of discussion are presented in terms of effective energy resource utilization; ecology and environmental impact of the use of various forms of energy; community energy systems and heating and cooling of buildings and dwellings. Forty-one of the papers were processed earlier.

36807 (NP—25005, pp 11p, Paper 27) **Tribology and its effect on energy conservation.** Khemchandani, M.V. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Energy conservation can be accomplished by eliminating non-essential and wasteful expenditures of energy via design changes that reduce mechanical losses such as friction, windage, flexion, and drag in the transportation sector, electric utilities (steam turbines, gas

turbines, hydropower, and diesel units), manufacturing industries, and the commercial or residential sector. The percentage of energy wasted in each sector in India is calculated. Specific energy wasted in the transportation sector and at electric utilities is identified. Areas where specific energy savings may be made are: bearings, water glands, labyrinth seals, turbine windage, exhaust losses, generator windage, and piping losses.

BUILDINGS

REFER ALSO TO CITATION(S) 36293, 36612, 36613, 36706, 37089, 37090

36808 (CONF-800972—1) **Reflective insulating blinds for window applications.** Shapira, H.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From 1980 Department of Energy passive and hybird solar energy program update meeting; Washington, DC, USA (21 Sep 1980).

A growing number of designs for direct-gain space heating are currently offered to the public. While these work well in some cases, side-effects of direct solar radiation provide some obstacles to wide acceptance of these designs. A novel-type blind which will improve the performance of direct-gain space heating is being developed at Oak Ridge National Laboratory. The background leading to the conception of RIB (Reflective Insulating Blinds unit) is discussed. Technical considerations are discussed covering issues such as: sizing, material selection, mounting mechanism and mode, operation controls, applications, and general design features. A discussion on commercialization efforts is presented.

36809 (CONF-8006120—1) **Role of conservation in planning for an energy emergency: home and work-place energy use.** Carlsmith, R.S. (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01.

From Contingency planning for an energy emergency conference; Stanford, CA, USA (16 Jun 1980).

Prospects for making substantial reductions in energy consumption in the residential, commercial, and industrial sectors are discussed. Steps to deal with an emergency and with preparations that can be started now to reduce our vulnerability are described. A large amount of energy conservation has occurred since 1973. As a result, 1980 consumption will be about 83 EJ instead of 104 EJ. Much of this energy conservation has come about from increased efficiency, as indicated by the fact that the energy/GNP ratio has dropped from 64 MJ/1972 dollar in 1973 to 58 MJ/1972 dollar in 1979. Higher energy prices have been and will continue to be the principal driving force for conservation. However, there are a number of serious barriers. Because of these barriers Congress has promulgated a program of encouraging conservation through regulations, financial measures, and information programs. Some of the most important are energy performance standards for new buildings, assistance in retrofitting residential buildings, and grants for institutional buildings. The planning for emergency situations remains incomplete. Proposed emergency measures (with the exception of gasoline rationing) focus largely on reduction of nonessential uses of energy. The potential reductions achievable by such measures would fall far short of the requirements in a serious emergency such as a cutoff of all imports from the mid-east. There remains an urgent need for detailed planning of allocation, distribution, pricing, and enforcement procedures for a major emergency.

36810 (COO—1340-73) **Energy-consumption modelling.** Reiter, E.R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1980. Contract AS02-76EV01340. 81p. (CONF-8004113—1). NTIS, PC A05/MF A01.

From NOAA the economic impact of climate conference; Columbia, MO, USA (11 Apr 1980).

A highly sophisticated and accurate approach is described to compute on an hourly or daily basis the energy consumption for space heating by individual buildings, urban sectors, and whole cities. The need for models and specifically weather-sensitive models, composite models, and space-heating models are discussed. Development of the Colorado State University Model, based on heat-transfer equations and on a heuristic, adaptive, self-organizing computation learning approach, is described. Results of modeling energy consumption by the city of Minneapolis and Cheyenne are given. Some data on energy consumption in individual buildings are included.

36811 (COO—2911-5) **Development and demonstration of Stirling/Rankine heat activated heat pump.** (General Electric Co., Philadelphia, PA (USA). Space Div.). 1979. Contract AC02-77CS20043. 136p. NTIS, PC A07/MF A01.

In January 1975, General Electric embarked with the American Gas Association (AGA) on a multi-phase program for the development of a Gas Heat Pump (GHP). The Department of Energy (DOE) joined General Electric and the AGA in the program in 1976, and the Gas Research Institute assumed responsibility for the program from the AGA in 1977. Phase I of the program was completed in December 1975, and Phase II was initiated in February 1976. The objective of the Phase II program is to demonstrate that the performance estimates generated during Phase I can be realized and that cost goals are realistic. Program effort during the seventh 6-month period of Phase II was concentrated on completion of the Proto 2 detail design, parts fabrication and procurement and the initiation of component tests. In addition, test facilities were modified and upgraded and field test criteria and site selection activities were initiated. The major accomplishments during the January to June 1979 reporting period are summarized. Detailed descriptions of the program progress on each subsystem and the system design are presented. (LCL)

36812 (DOE/CS/20413—01) **Status of thermal imaging technology as applied to conservation-update 1.** Snow, F.J.; Wood, J.T.; Barthle, R.C. (DCS Corp., Arlington, VA (USA)). Jul 1980. Contract AC01-78CS20413. 200p. NTIS, PC A09/MF A01.

This document updates the 1978 report on the status of thermal imaging technology as applied to energy conservation in buildings. Thermal imaging technology is discussed in terms of airborne surveys, ground survey programs, and application needs such as standards development and lower cost equipment. Information on the various thermal imaging devices was obtained from manufacturer's standard product literature. Listings are provided of infrared projects of the DOE building diagnostics program, of aerial thermographic firms, and of aerial survey programs. (LCL)

36813 (DOE/PE—03871-01, pp 17.1-17.32) **Heat pumps.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The operation, performance, applications, and owning and operating costs of heat pumps located at various US geographical regions are discussed. (LCL)

36814 (LBL—10707) **Real energy savings with electronic ballasts.** Verderber, R.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 26p. (EEB-L—80-01). NTIS, PC A03/MF A01.

The real energy savings that can be obtained with electronically ballasted fluorescent lamps compared to lamps operated with standard core-coil ballasts exceeds 40%. This savings is realized because of improvement in the intrinsic efficiency (20 to 25%) of the electronic ballast, and because of the manner a lighting designer can best meet the proper light level, for a lighting design. The astute lighting designer can reduce energy use by over 70% in an appropriate space with this new tool by the use of natural illumination (daylighting). Together with these gains are improvements in the comfort and quality of the illumination. Fluoresent lamps operated with some electronic ballasts exhibit no flicker and, in addition, provide each lighting fixture with the possibility of tuning its output to the needs of the occupant. These latter techniques should contribute to the occupants' productivity.

36815 (ORNL/Sub—7556/2) **Corrosion testing of urea-formaldehyde foam insulating material.** Weil, R.; Graviano, A.; Sheppard, K. (Stevens Inst. of Tech., Hoboken, NJ (USA). Dept. of Materials and Metallurgical Engineering). Sep 1980. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01.

Two tests of the corrosiveness of urea-formaldehyde (UF) foam insulating materials were compared. One test, the Timm test, had test coupons foamed in place. In the second, the Canadian test, blocks of foam already set were placed in contact with test coupons. The Timm test uses 10 gage thick coupons, while the Canadian test specifies 3 mil thick ones. Two samples of UF foam were tested by the Timm and the Canadian tests. The electrical-resistance probes showed that the corrosion rate against steel was initially quite high, of the order of 12 to 20 mpy (mils per year). After about 20 days, the rate was almost zero. In the Timm test, the corrosion rates of steel coupons were of the order to 0.5 to 2 mpy when averaged over the 28 or 56 day test period. The greater corrosion rate of the thick coupons in the Canadian test as well as poor reproducibility of the corrosion rates was attributed primarily to variations in the contact areas between the sample and the UF foam. The corrosion rates of galvanized steel coupons in the Canadian test in several cases exceeded the failure value. In the Timm test, the corrosion rates averaged over the whole test period were quite low. The corrosion rates of copper and aluminum in both tests were quite low. On the basis of the results of this study the following recommendations for a corrosion-test procedure for UF foam were made: two corrosion tests should be conducted, one for foam while curing and one after it has stabilized; the Timm test for corrosiveness while curing should be used, but for only 1 to 2 days; the test for corrosiveness after stabilizing should be of the accelerated type such as the Canadian one. To insure a constant-contact area, thicker coupons should be

used; and the coupons for both tests should have a controlled part of the area not in contact with the foam to simulate field conditions.

36816 Heat pump system defrost control. Mueller, D.; Serber, S. (to Honeywell Inc). US Patent 4,209,994. 1 Jul 1980. Filed date 24 Oct 1978. vpp.

A description is given of an outdoor coil defrost control system (hereinafter "defrost control system") for a reverse cycle refrigeration system (hereinafter "system") for heating and cooling a building wherein said system comprises refrigerant compression means, an indoor coil, an outdoor coil, and refrigerant conduit means connecting said compression means and said coils, said defrost control system comprising: outdoor air temperature sensing means (hereinafter "toda") having an output indicative of outdoor air temperature; outdoor coil temperature sensing means (hereinafter "todc") having an output indicative of the temperature of said outdoor coil; means (hereinafter "com") operatively associated with said compression means and adapted to have an output indicative of the operation of said compression means; and controller means having operative connections to said toda, todc, and com so as to receive the outputs thereof, said controller having a timing function which is initiated upon (I) the outdoor coil temperature as sensed by todc being at or below a preselected value and (II) said compression means being operated, the duration of said timing function being determined on a substantially continuous basis by the magnitude of the outdoor air temperature as sensed by toda, and said controller means having an operative connection to said system and being adapted, upon completion of said timing function, to place said system into an outdoor coil defrost mode of operation.

36817 Controls for room air conditioner with timer and power saver. Ferdelman, D. (to White Consolidated Industries, InC.). US Patent 4,209,995. 1 Jul 1980. Filed date 23 Jan 1979. vpp.

A description is given of a self-contained room air conditioner unit including a housing enclosing a compressor driven by a motor, a condenser, an evaporator connected in a refrigeration circuit and a fan driven by a fan motor for circulating room air to be cooled at high and low speeds into heat exchange relation with said evaporator; and in which said housing has a room-side section with a control area thereon; an electric timer located at said control area, said timer including a time switch having contacts adapted to be opened and closed and a timer motor electrically connected in a control circuit between first and second supply conductors whereby to run continuously with said unit, thermostat switch means operative to cycle the compressor motor in response to the temperature of said circulating air; the improvement wherein main function manually actuable switch means located at said control area and connected in said circuit having four interlocked switches for alternatively selecting a unit first off position, a second posit ion operative to connect a first terminal of said fan motor to said first supply conductor for a low speed fan only function, a third position operative to connect said first terminal of said fan motor and one side of said compressor motor to said first supply conductor for a low fan speed cooling function and a fourth position operative to connect a second terminal of said fan motor and said one side of said compressor motor to said first supply conductor for a high fan speed cooling function.

36818 Film-type storm window . Li, Y. US Patent 4,210,191. 1 Jul 1980. Filed date 30 Jun 1978. vpp.

A description is given of a protective flexible membrane structure installed in a framed opening with corners comprising a peripheral tension element, said tension element being attached to said membrane in curved relationship to said framed opening, said tensioning element lying in the plane of said membrane, the segments of said peripheral tension element at each side of said opening lying along segments of a circle, each of said segments lying alongside a side of said frame opening and in the plane of said membrane and corner tensioning means in the corners of said framed opening to apply force to said tension element whereby each of said segments of said perpheral tension element hold a side of said membrane in plane relationship within said opening and adjacent to the corresponding side of said framed opening.

36819 Energy saving device for habitable building enclosures having a heat changing system. Vary, R. US Patent 4,210,200. 1 Jul 1980. Filed date 29 Jun 1978. vpp.

In a building construction embodying a habitable enclosure, the combination of a temperature varying system fo rmaintaining a predetermined temperature in said enclosure, a housing for said temperature varying system which housing is disposed as to be subject to outdoor temperature influences, an upper register constituting an opening for passage of air between the upper portions of said habitable enclosure and said housing, and a lower register constituting an opening for passage of air between the lower portions of saidhabitable enclosure and said housing, a mechanical shutter arrangement interposed in at least one of said registers and being operable to block passsage of air between the habitable enclosure and the interior of said housing, a solenoid device for actuating said mechanical shutter between open and closed postions, and means for actuating said solenoid device upon operation of said temperature varying system.

36820 Heating and cooling loads comparison of three building-simulation models for residences: TWOZONE, DOE-1, and NBSLD. Gadgil, A.; Goldstein, D.; Mass, J. (Univ of California, Lawrence Berkeley Lab). pp 356-264 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper compares three public domain computer programs - TWOZONE, DOE-1/DOE-2, and NBSLD/BLAST-1.2 - in terms of their modeling methodologies and in terms of their predictions for residential buildings over a wide range of climates and insulation levels. The annual heating and cooling loads are generally found to be consistent between programs. 12 refs.

36821 Regional and climatic comparison factors in design. Stein, R.G. (Stein Partnership, New York, NY). pp 1086-1089 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

One of the underlying problems facing architectural designers is to maintain a perspective on what the purpose of building design is. It is not to produce buildings whose major virtue is low energy use if that is achieved at the expense of the fundamental performance of the building or if the program is seriously distorted in order to produce visibly energy-responsive building form. Due to regional and climatic considerations that affect architectural design, this study concludes that excellent climatological data along with good, precise programmatic information, site information, information about the surrounding terrain and the relationship of the new building and its neighbors, knowledge of the technology of buildings, and the characteristics of different materials allow for optimal design.

36822 Mobile window thermal test facility (MOWITT). Klems, J.H.; Selkowitz, S.E. (Univ of Calif, Lawrence Berkeley Lab). pp A72-A79 of Changing energy-use futures. Vol. 4. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper describes a mobile facility for testing the net energy performance of windows under selected conditions of weather and orientation. Currently being built as part of the DOE/LBL Energy Efficient Window Program, the facility consists of four full-sized, heavily insulated rooms with controlled internal temperature and accurately monitored (heating or cooling) energy. Details of the trailer design and instrumentation are presented. 6 refs.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 36862

36823 (CONF-800966—1) **Performance and economics of using heat pump desuperheaters for residential water heating.** Abbatiello, L.A.; Nephew, Ballou, M.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From Conference on waste heat recovery for energy conservation: residential and light commercial heat pumps; West Lafayette, IN, USA (15 Sep 1980).

The efficiencies and economics of three methods of water heating are compared, i.e., desuperheater and conventional gas and electric water heaters. The homeowner using a desuperheater water heater system should expect effective annual water heating COPs which range from 1.3 for northern cities to 2.9 in southern cities. The average consumer could expect to save between 800 and 2500 kWh/year if he is presently heating water with a conventional electric water heater. Should the homeowner elect to install a heat pump water heater within the thermal envelope of his air-to-air heat pumped home, he could expect similar savings. Even though the consumer can achieve significant energy savings, these savings may not translate into significantly different life cycle economics. The major economic conclusions of this study are: the desuperheater water heater can save a significant amount of energy at attractive life-cycle costs and acceptable first costs if the owner is choosing between electrically powered alternatives; heat pump water heaters offer savings which are comparable to those of the desuperheater system in all regions of the country; water heating with natural gas still offers the lowest first and life-cycle costs of all alternatives.

36824 (DOE/EIA/AR—0232) **Replacement energy costs in the residential and commercial sector 1985, 1990 and 1995. Analysis report AR/EUA/80-23.** Rodekohr, M. (Department of Energy, Washington, DC (USA). Office of Energy Use Analysis). Jul 1980. 37p. NTIS, PC A03/MF A01.

Replacement costs are the costs to the nation for providing the consumer with an additional unit of a given form of energy, excluding energy related subsidies and taxes and including the value of selected externalities. The results of this analysis show that energy replacement costs of all fuels are expected to grow in real terms over the 1985 to 1995 time period, with natural gas experiencing the largest growth rate and electricity experiencing the lowest growth rate. The large growth rate of natural gas prices is due to the wellhead price decontrol provisions of the Natural Gas Policy Act of 1978. The incremental pricing provisions of this legislation keeps the average natural gas price well below the marginal natural gas price. The low growth rate of electricity replacement cost is due to a relatively (to recent history) small demand for new capital equipment expenditures in this sector which are, in turn, due to the relatively (to recent history) low electricity demand growth rate; and, regional variation in electricity prices is overstated due to the modeling assumption that electricity cannot be sold between regions. This assumption implies that all power produced in a region can only be sold in that region when, in fact, electricity is often sold between regions. Interregional selling and production of electricity tends to make regional price differences lower than what appears in this analysis.

36825 (DOE/PE—03871-01, pp 18.1-18.13) **Coal-based domestic heating.** Nov 1979.

In Distributed energy systems: a review of related technologies.

Domestic heating using hand-stoked or mechanically stoked-coal furnaces or fluidized-bed combustors burning coal is discussed in terms of technical feasibility, costs, safety, and environmental effects. It is concluded that the cost of coal furnaces, the safety and environmental problems associated with coal combustion, and the requirements for a coal delivery system for domestic users make a return to coal-based domestic heating unlikely. (LCL)

36826 (NP—25125) **Electric power replacing oil: the development of hot water supplies to private households in the Federal Republic of Germany.** (Hauptberatungsstelle fuer Elektrizitaetsanwendung e.V., Frankfurt am Main (Germany, F.R.)). Oct 1979. 13p. (In German). NTIS (US Sales Only), PC A02/MF A01.

With 95% of energy supplies imported, it is evident how important it is in the framework of energy supply to replace petroleum with domestic energy sources which are not subject to crisis. The energy program of the Federal Republic of Germany established in 1973, and continued from 1974 to 1977, has focussed on that tissue. The paper at hand intends to show favorable prospects involved in substituting oil by heating hot water with electric power. Generally available statistics and analyses were the basis as well as a market enquiry covering 35,000 households, the evaluation of which was concluded in 1979. This material clearly shows that 27% of the total final energy consumption in the FRG go to the consumption area household, out of which 9% - corresponding to 2.4% of the total needs of final energy - go to hot water supplies. At first glance, this figure seems small. However, households use as much energy as, e.g., the total traffic of rail, ship and air in the FRG. The objective to be attained by this compilation is to make useful facts and figures available by illustrating the situation and presenting the course of discussions to be expected concerning energy policy.

36827 **Sheet metal fireplace stove with improved draft .** Kincaid, D. US Patent 4,210,119. 1 Jul 1980. Filed date 7 Jul 1977. vpp.

An improved fireplace stove for heating a building or the like comprising: a sheet metal fire box, said fire box comprising laterally spaced, vertically extending sheet metal end walls, said end walls being of polygonal shape, and vertically spaced top and bottom walls extending horizontally between said end walls, a vertical rear wall extending between said end walls, front and rear lower inclined sidewalls extending between said end walls and being inclined upwardly and outwardly from respective edges of said horizontal bottom walls, said rear lower inclined sidewall being joined to the lower edge of said vertical rear wall, a rear upper inclined sidewall extending between said end walls and being inclined downwardly and rearwardly from the edge of said top wall and being joined thereto to the upper edge of the rear wall, fire brick lining the inner surface of said bottom wall and at least portions of adjacent inclined lower sidewalls, a flue stck fixed to said sheet metal fire box being open to the fire box interior at the bottom theref and extending vertically above said top wall at the rear of said stove, a metal backsplash plate fixedly mounted to the rear of said sheet metal fire box and spaced therefrom and extending vertically upwardly above said fire box top wall and including an inclined portion facing the lower rear inclined sidewall and forming on the exterior of said sheet metal fire box a heated air flow path for air flow upwardly and away from said backsplash plate to convect heat toward the front of the stove and the flow of relatively cool air beneath the sheet metal fire box to maintain the bottom of the fire box cool, fans means for forcing air between said sheet metal fire box and said metal backsplash plate and for forcibly causing air to flow upwardly and away from the back splash plate and downwardly beneath said sheet metal fire box.

36828 **Residential electricity demand in California: results and methodology.** Blumstein, C.; Jaske, M.R.; Gorin, T.; Carner, D.; Carroll, J.; George, S.; Greene, B.; Larson, L.; Paige, D.; Sarvate, S. (Lawrence Berkeley Lab., Calif). pp A30-A40 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

An end-use model of residential electricity sales was developed for California and used to forecast sales to the year 2000 by major utility service area. Sales are disaggregated by 12 end-uses, 3 housing types, and 11 climate zones. End-use saturation estimates wee developed from analyses of data from the 1970 Census of Housing and from extensive surveys conducted by the California utilities in 1977. Unit energy-consumption estimates were derived using a variety of methods, including computer calculations of space-conditioning loads and statistical analysis of utility billing data combined with responses to saturation surveys. 12 refs.

36829 **Thermal mass: its role in residential construction.** Curtis, B.; Andersson, B.; Kammerud, R.; Place, W.; Whitley, K. (Univ. of California, Lawrence Berkeley Lab.). pp 1294-1301 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The effects of thermal mass on the energy consumption of residential structures were studied in four climates. The computer program **BLAST** was used to determine heating and cooling loads of residential structures as a function of glazing distribution, level of thermal mass, insulation location, and ground coupling. The objective of this study is to assess the potential benefits that might accrue from increased use of thermal mass in otherwise conventional residential construction. Past evaluations of massive construction have typically ignored many factors which are important for determining the energy consumption of a building: occupancy, internal thermal loads, infiltration, and the rest of the building envelope. This study evaluates mass in the context of the entire building. 4 refs.

36830 **Infiltration and air leakage comparisons: conventional and energy-efficient housing designs.** Grimsrud, D.T.; Sherman, M.H.; Blomsterberg, A.K.; Rosenfeld, A.H. (Univ. of California, Lawrence Berkeley Lab.). pp 1351-1358 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Generalized modeling of air-infiltration rates in structures is complicated by insufficient information about the construction quality of the structure and the local terrain in the vicinity of the building. Air-leakage measurements using fan pressurization give information about construction quality while surface-pressure measurements together with weather data can be used to deduce information about the influence of local terrain on infiltration rates. This paper describes results of measurements of air leakage, surface pressures and natural infiltration rates for several conventional houses and several energy-efficient houses located throughout the United States. It is found that, within the limits of a crude model, there was reasonable agreement between measurements and predictions. 6 refs.

36831 **In-situ measurements of net fireplace efficiency using electric co-heating.** Modera, M.P.; Sonderegger, R.C. (Univ. of California, Lawrence Berkeley Lab.). pp 1397-1405 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

A new "electric coheating" technique to measure net fireplace efficiency in-situ has been developed at Lawrence Berkeley Laboratory. It measures the net heat gain (radiation minus air-infiltration debit) from a fireplace as a decrease in electric heating required to keep a constant house temperature. In addition, the air-infiltration rate of the whole house is measured. By correlating the electric consumption and the infiltration load, both the gross and the net efficiency can be calculated. The performance of an open fireplace in three operating modes and the performance of a typical fireplace accessory were investigated in the course of preliminary work. Using natural gas as a fuel, the net fireplace efficiency was increased from 1.1% with an open damper to approximately 60% by almost completely closing the damper. 6 refs.

36832 **Indoor air quality measurements in energy-efficient houses.** Berk, J.V.; Hollowell, C.D.; Lin, C. (Lawrence Berkeley Lab, Calif). *Proc. Air Pollut. Control Assoc.;* **2**: vp(1979).

The potential impact of reduced ventilation on indoor air quality is being assessed in a field monitoring program by the Lawrence Berkeley Laboratory. Three houses, designed to be particularly energy-efficient, were monitored using a mobile laboratory. Parameters measured included infiltration rate, carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, ozone, sulfur dioxide, formaldehyde, total aldehydes, and particulates. 11 refs.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 36824

TRANSPORTATION

36833 Energy economics and alternative forms of transportation. Hill, L.G.; Santini, D.J.; Stenehjem, E.J.; Hoover, L.J. (Argonne National Lab., Ill). pp 165-173 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

This paper addresses the economic effects of possible future substitution of the mature Brayton gas turbine and Stirling automobile engines for the currently-used gasoline-powered internal-combustion engine. Initial estimates are generated by a computer model known as TECNET, which incorporates an input-output-based economic-forecasting model (INFORUM), and by independent computations. The study indicates that one version of these engines could suffer from domestic-mineral mining constraints, but substantially reduce demands for petroleum-related products. 13 refs.

36834 Some problems of definition raised by a transportation energy data base. Hooker, J. (Oak Ridge National Lab., Tenn). pp 286-293 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Oak Ridge National Laboratory has addressed the definitional problems in its development of a transportation energy data base for the Department of Energy. One is the fundamental problem of analyzing the notion of energy consumption itself. The second definitional problem is that of distinguishing between energy used for transportation from that used for other purposes. The distinction can be reasonably drawn in a number of ways, and the paper explores the implications and usefulness of a few of these ways. 7 refs.

36835 ORNL light-duty motor vehicle and gasoline consumption data base and selected applications. Rose, A.B. (Oak Ridge National Lab., Tenn). pp 300-306 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

In conjunction with the development of a state-level gasoline demand model, the Transportation Energy Program at Oak Ridge National Laboratory has assembled a unique, machine-readable data base relating to the light-duty motor-vehicle fleet, its characteristics, and energy-use patterns from 1966-1979. Following a description of the basic data elements, this paper describes how these data were applied in developing state-level fleet fuel economies taking into account such influencing factors as variations in ambient conditions and vehicle-usage patterns. 11 refs.

RAILWAY

REFER ALSO TO CITATION(S) 36735

LAND AND ROADWAY

36836 (AD-A—079555/9) **User guide for the Air Force Base Automotive Transportation Simulation Model - BATS. Volume 2. Documentation. Final report Jun 78-Sep 79.** Sandys, R. (SRI International, Menlo Park, CA (USA)). Sep 1979. Contract F08635-76-D-0132. 348p. NTIS, PC A15/MF A01.

The Base Automotive Transportation Simulation (BATS) Model is a transportation planning and traffic flow model designed to simulate traffic volumes and flows on an air base. The principal model inputs are a road network, land use zones, demographic varibles, and gate counts. The land use zones and demographic variables are used to assign volumes to the road network, and these volumes are calibrated using the gate counts. The flow characteristics on each road in the network are simulated using the volumes assigned. Average speed and volumes are the results of the model and these may be directly input to the Air Quality Assessment Model (AQAM) to estimate pollutant emissions and dispersion from traffic sources. A volume flow plot of the network is an optional output of the model.

36837 (AD-A—079556/7) **User guide for the Air Force Base Automotive Transportation Simulation Model - BATS. Volume 3. Documentation, appendices d and e. Final report Jun 78-Sep 79.** Sandys, R. (SRI International, Menlo Park, CA (USA)). Sep 1979. Contract F08635-76-D-0132. 223p. NTIS, PC A10/MF A01.

For abstract see AD-A079 555.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 36739

36838 Process optimization of industrial energy use. Pilati, D.A.; Sparrow, F.T. (Brookhaven National Lab., Upton, NY). pp 383-389 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The Brookhaven National Laboratory Industry Model Program (IMP) has undertaken development of a set of industry-specific process-optimization models. These models are to be used for energy-use projections, energy-policy analyses and process-technology assessments. Applications of the models currently under development show that system-wide energy impacts may be very different from engineering estimates. 8 refs.

36839 Computer simulator of energy flow through individuals, families, and extended families of the high-altitude Quechua. Weinstein, D.A.; Brandt, C.C.; Shugart, H.H. (Oak Ridge National Lab., Tenn). pp 514-520 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The Quechua Indians of the Peruvian High Andes are an example of a human population which has developed special cultural adaptations to deal with hypocaloric stress imposed by a harsh environment. A highly detailed human ecosystem model, NUNOA, has been developed which simulates the yearly energy balance of individuals, families, and extended families in a hypothetical farming and herding Quechua community in the high Andes. Unlike most population models, which use sets of differential equations with collective variables like number or biomass density, this is a stochastic model that considers each individual separately. 16 refs.

36840 Management of maintenance for energy conservation. Miller, E.L. (US DOE, Richland, WA). pp 1664-1671 of Changing energy-use futures. Vol. 4. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Properly maintaining the physical plant of highly technical installations in an efficient running order is becoming continually more complex and costly. Steadily increasing labor and material costs and rapid changes in technology require that the activities of today's maintenance organizations be managed so efficiently that they utilize their available resources to maximum effect. This paper discusses some techniques of management.

ENERGY SOURCES

REFER ALSO TO CITATION(S) 36612, 36613, 36809, 37089, 37090

36841 (ORNL/CON—54) **Projection of energy use in agricultural production by fuel type and at the state level.** Fox, A.; Nguyen, H.D.; Thomas, B. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 63p. NTIS, PC A04/MF A01.

Energy is essential for US agricultural production. It is consumed either as a direct input (fuel for tractors, grain drying, irrigation, etc.) or as an indirect input (such as energy invested in fertilizers and pesticides). The use of energy in agricultural production in recent years is examined and future direct and indirect energy inputs in agricultural production for each state in the US are projected. Alternative projections under various assumptions of production levels and production practices are presented. The projections are based on estimated 1974 state energy input-output matrices which are adjusted for possible future changes in production technology and fuel choices.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 36706, 36709

36842 (BNL—51155) **Polyketones and polysulfones for conservation in the ethylene polymer industry. Progress report No. 6, July-September 1979.** Steinberg, M.; Johnson, R.; Elling, D.; Cordes, W.; Goodman, D. (Brookhaven National Lab., Upton, NY (USA)). Jan 1980. Contract AC02-76CH00016. 34p. NTIS, PC A03/MF A01.

The characterization study on ethylene-CO (Et-CO) copolymers was concluded. The copolymers were prepared at various levels of CO composition, and with several methods loss of catalysis, including free-radical, metallic, and ^{60}Co irradiation. Et-CO copolymers exhibit crystallinity related to the alternating polyketone structure which increasees logarithmically with CO content over the range 28% to 49% CO. The melting point increases in essentially the same manner as crystallinity. The structure of the copolymers is independent of the type of catalysis used. Highly crystalline copolymers showed discoloration and loss of crystallinity at 140°C, whether in air or N_2. Discoloration is severe at 210°C, and after heating at 280°C for 1 h, essentially all crystallinity was lost. Press molding of highly crystalline copolymer at 260°C for 5 minutes showed 38.8% loss of crystallinity and appearance of H_2O and olefinic unsaturation. Reaction kinetic studies on the low-pressure (< 5 atm) gas-phase copolymerization of ethylene - SO_2 (Et-SO_2) mixtures at a dose rate of 0.54 Mrad/h and at 10 to 13°C were continued. Recharging a reaction system repeatedly with a mixture containing 19.2 mole % S_2 initially resulted in a general increase in G-value from 4.60×10^4 to 7.10×10^4 molecules/100eV and a factor of 4.6 decrease in reaction time for the attainment of peak rate and G-value. Low-pressure (< 5 atm) gas-phase ^{60}Co gamma copolymerization at a dose rate of 0.56 Mrad/h and at 10 to 13°C of a 1-butene-SO_2 mixture of approximately equimolar composition resulted in peak and overall G-values of 340 and 156, respectively, and product of nearly equimolar composition. For safety reasons the experimental radiation facility for conducting the copolymer studies was relocated to another building and a 5300 Ci ^{60}Co gamma radiation source was transferred to the new facility.

36843 (BNL—51234) **Polysulfones for conservation in the ethylene polymer industry. Progress report No. 7, October 1979-March 1980.** Steinberg, M.; Johnson, R.; Elling, D.; Bernstein, P.; Varker, A.E. (Brookhaven National Lab., Upton, NY (USA)). Jun 1980. Contract AC02-76CH00016. 21p. NTIS, PC A02/MF A01.

Ethylene-SO_2 polysulfone copolymers were prepared by ^{60}Co gamma radiation, as well as by electron-beam radiation and by thermocatalysis, as a means of incorporating a polluting waste product material such as SO_2 into ethylene polymers for the purpose of conserving ethylene feedstock. Ethylene-SO_2 copolymer was pressur- molded into discs which had a high degree of hardness as well as partial transparency, but were also very brittle. Differential Scanning Calorimetry (DSC) and Thermal Gravimetric Analysis (TGA) indicated peak decomposition at 350°C. Long term heat aging tests showed stability to 175°C and initiation of decomposition at 200°C in air after 900 h. Decomposition became severe as the temperature was increased to 300°C. The activation energies for decomposition were 57.3 and 56.8 kcal/mole for liquid-phase and gas-phase formed copolymers, respectively. The ethylene-SO_2 copolymer was modified by the incorporation of monomeric styrene, 2-vinyl pyridine, 4-vinyl pyridine, and N-vinyl pyrrolidine. A summary of characterization studies by INCO which includes solubility, infra-red and x-ray analysis of the ethylene-SO_2 copolymer and with additives are presented.

36844 (COO—4881-16) **Energy savings by means of fuel cell electrodes in electro-chemical industries. Progress report, November 1, 1979-January 31, 1980.** Bar-Ilan, A.; Juda, W.; Allen, R.J.; Lindstrom, R.W. (Prototech Co., Newton Highlands, MA (USA)). 18 Apr 1980. Contract AC02-78ET25309. 42p. NTIS, PC A03/MF A01.

Zinc electrowinning data, obtained with hydrogen depolarized anodes operating in a plant feed electrolyte at 55°C, are presented in this quarterly report for investigations involving the following: performance of an anode containing a low platinum loading, i.e. 0.09 mg/cm² instead of the typical 0.33 mg/cm², and an anode catalyzed with palladium instead of platinum; establishment of a feed and bleed system to maintain a constant electrolyte composition; exploratory experiments on the effect of the rate and mode of electrolyte flow on the quality of the zinc plate at high current densities; performance of the anode with feeds of varying degrees of purification pre-treatment, and containing either 50 or 150 g/l Zn^{++}; the effect upon cell voltage of decreasing the hydrogen flowrate to the anode by dilution of the feed gas with nitrogen; the effect upon cell voltage of increasing the back pressure of the hydrogen gas fed to the anode; the effect upon energy consumption and current efficiency of varying the current density and the Zn^{++} concentration; trace elemental analysis of a cathodic zinc plate of commercial-size thickness, as produced using the catalytic H_2 anode; further comparison of the effects of feed solution purification; and performance of four different Prototech Pt anodes.

36845 (DOE/CS/40150—1) **Impact on energy conservation of automatic control systems utilization in the US pulp and paper industry.** Fam, S.S. (Thermo Electron Corp., Waltham, MA (USA)). 1978. Contract AC02-78CS40150. 87p. NTIS, PC A05/MF A01.

This study is concerned with the energy and other resource benefits resulting from the computerized automation of processes in the US pulp and paper industry. The primary objectives were to characterize the state of the art of computer controls in the industry and to pinpoint the problem areas that limit their further use. The study lasted approximately 4 months. An exhaustive survey of all the possible technologies in use, or under development, was not possible. The main conclusions are that the pulping and recovery operations offer the greatest potential for reducing energy use by computer control, and that effective hierarchical control at the plant level requires the integration of these operations into one or more control loops. No control system has been found that provides reliable, fully automated control of recovery boilers for an extended period of time. The total technical potential for fuel savings was estimated at 0.2 quadrillion Btu's a year, or the equivalent of 94,000 barrels of oil per day.

36846 (PNL—3143) **Analysis of the research and development effort in the private sector to reduce energy consumption in irrigated agriculture.** Rogers, E.A.; Cone, B.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 74p. NTIS, PC A04/MF A01.

Manufacturers of irrigation equipment perform research and development in an effort to improve or maintain their position in a very competitive market. The market forces and conditions that create the intense competition and provide incentive for invention are described. Particular emphasis is placed on the market force of increased energy costs, but the analysis is developed from the perspective that energy is but one of many inputs to agricultural production. The analysis is based upon published literature, patent activity profiles, microeconomic theory, and conversations with many representatives of the irrigation industry. The published literature provides an understanding of the historical development of irrigation technology, a description of the industry's structure, and various data, which were important for the quantitative analyses. The patent activity profiles, obtained from the US Patent Office, provided details of patent activity within the irrigation industry over the past decade. Microeconomic theory was used to estimate industry-wide research and development expenditures on energy-conserving products. The results of these analyses were then compared with the insights gained from conversations with the industry representatives.

36847 **Refrigeration system having improved heat transfer and reduce power requirement for various evaporative refrigerants.** Miller, B. US Patent 4,210,001. 1 Jul 1980. Filed date 31 Jul 1978. vpp.

A description is given of an improved refrigerating system of the type which includes (A) an evaporator for circulating a fluid refrigerate therethrough to absorb heat from a refrigerating medium, whereby said medium is cooled and said refrigerant is converted from a liquid to a gas, (B) an oil lubricated compressor connected in receiving relation to said evaporator for compressing and superheating said gas, (C) a condenser connected in receiving relation to said compressor for condensing said compressed gas to form a liquid, and (D) a receiver connected in liquid receiving relation to said condenser for storing said liquid and connected in liquid supplying relation to said evaporator, the improvement comprising (E) heat exchanger means having a liquid refrigerant confining shell and a heat exchanger tube disposed in said shell, an inlet end of said tube being connected in receiving relation to said compressor for receiving said compressed, superheated gas therein, said shell having an inlet port connected in receiving relation to an outlet port of said condenser for circulating a portion of the liquid refrigerant condensed in said condenser about said tube to partially desuperheat said compressed gas, and (F) an impurity removing oil-mist separator/collector unit connected in receiving relation to an outlet end of said tube for removing impurities, including oil, from said partially desuperheated gas, said unit being connected in supplying relation to said condenser for supplying cleaned, partially desuperheated gas to said condenser.

36848 **Maufacture of raw cane sugar.** Pepeekeo, HI; Hilo Coast Processing Company (1980). 4p. (NP—25111).

Procedures used at the Pepeekeo Sugar Factory in Hawaii for producing commercial sugar, molasses and bagasse from harvested sugar cane are described. The molasses is marketed, the sugar is refined elsewhere, and the bagasse is burned to produce steam and electric power for the Pepeekeo plant. (LCL)

36849 **Effects of natural gas price increases on Texas High Plains irrigation, 1976-2025.** Young, K.B.; Coomer, J.M. Washington, DC; Department of Agriculture (1980). 36p.

The effects of increasing natural gas prices on crop water use and net crop income under alternative crop prices were determined for a 32-county region of the Texas High Plains. An increase in natural gas prices could substantially reduce irrigation over the projection period, based on results from a recursive linear programming model. The price of natural gas, and not the quantity of

remaining ground water reserves, may now become the restrictive factor. Irrigation of major corps - based on increasing natural gas prices - is projected to end in 1995 and annual net crop income to fall from $277 million to $164 million.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 36803

36850 Space heater heat recovery system . Dosmann, J. US Patent 4,210,102. 1 Jul 1980. Filed date 17 Nov 1978. vpp.

A description is given of a space heating system having a hot air, fuel fired furnace with a cold air inlet passage and a hot air outlet passage, a heat recovery system: comprising an exhaust pipe for connecting the furnace to a flue, a damper in said exhaust pipe, a heat exchanger unit having a chamber and a set of water coils therein, said heat exchanger unit being located at least in part below said exhaust pipe, a pipe connected to said exhaust pipe on the anterior side of said damper andextending downwardly to the lower portion of said chamber, a pipe connecting the upper part of said chamber with said exhaust pipe on the posterior side of said damper, a water holding tank, upper and lower conduits connecting said tank with said set of coils, a bank of coils in one of said passages of the furnace, a fan for forcing T he furnace exhaust gases through said downwardly extending pipe and the chamber in aid heat exchanger unit and returning the gases to said exhaust pipe and water supply and return conduits connecting said holding tanks with said bank of coils for heating the air flowing to the space to be heated.

36851 Method for recovering heat in a vapor degreasing apparatus . Grunewald, H.; Moree, H. (to Electrokemiska AB (Sweden)). US Patent 4,210,461. 1 Jul 1980. Priority date 2 Jun 1975, Sweden, vpp.

A description os given of a method of heat control in a solvent vapor degreasing apparatus, said apparatus comprising a tank containing a liquid solvent high in the bottom thereof, and with a solvent vapor zone for degreasing objects above said liquid solvent bath, said method comprising the steps of: A. heating the bottom of said tank for heating said liquid to be continuously at the boiling point, thereby generating vapor from said liquid solvent bath; B. cooling a region defined by a cooling coil at least partially surrounded the inside of said tank at a level above said solvent vapor zone; C. recovering the vapor in a liquid form from said cooling region and returning a first portion of the recovered liquid to said liquid solvent bath and diverting a second portion of the recovered liquid into said cooling coil of a heat pump means; D. supplying heat absorbed by said cooling coil in said cooling region from said solvent vapor to a circulating heatcarrying medium of a system including said heat pump means, in which the medium is vaporized and thereafter is compressed and discharging the vaporized and compressed medium at high temperature and pressure directly into the liquid solvent bath, said heat-carrying medium including said second portion of said recovered liquid solvent; and E. supplying extra energy from outside the system including the heat pump means for operation of said system and cooling away excess heat outside the degreasing apparatus for balancing said system.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 35910, 36035, 36316, 36331, 36610, 36848, 37085, 37086

36852 (CONF-8004114—) **Waste oil management conference.** (Amoco Research Center, Naperville, IL (USA)). 3 Apr 1980. 130p. TIC.

From Waste oil management conference; Naperville, IL, USA (3 Apr 1980).

Proceedings from a conference dealing with the conservation, reclamation, recycling and reuse of lubricating oils are presented. The following topics are discussed: in-plant oil accounting; regulatory aspects of waste oil disposal; measurements and standards for recycled oils; conservation measures, service reclamation techniques and processes; re-refining processes and products; quality control; a methodology for determining the economic viability of in-plant used oil recycling; and pollution control financing. Separate abstracts have been prepared for each item within the scope of the Energy Data Base. (DMC)

36853 (DOE/ET/10533—10) **Utilization of coal associated minerals. Quarterly report No. 10, January 1-March 31, 1980.** Slonaker, J.F.; Buttermore, W.H.; Carlisle, J.A.; Durham, D.L.; Muter, R.B.; Alderman, J.K. (West Virginia Univ., Morgantown (USA). Coal Research Bureau). 15 Jul 1980. Contract AS01-77ET10533. 15p. NTIS, PC A02/MF A01.

In the preceding quarterly report, it was reported that while sampling the Solvent Refined Coal II (SRC II) pilot plant at Fort Lewis, Washington, the plant went down and vacuum bottoms waste material representing the minerals flow at the last steady state condition were obtained. This plant has been sampled again and samples of the incoming feed coal, sized coal and vacuum bottoms waste material were obtained. As part of our effort to trace the same mineral suite through mining, preparation and conversion, new samples of feed coal, cleaned coal and refuse were obtained from the District 4 commercial preparation plant. This preparation plant supplies coal to the SRC II pilot plant at Fort Lewis, Washington. A study of the thermal insulating properties of fired flyash based structural materials was completed and is included.

36854 (NP—25005, pp 16p, Paper 22) **Energy waste materials.** Mital, C.K. (Indian Inst. of Tech., Bombay). 1980.

In Nonconventional sources of energy: notes on short-term course.

Prospects for the efficient utilization of solid wastes from municipal wastes, agricultural wastes, animal manures, industrial wastes, mining wastes, and litter are discussed. The amount of waste generated in India in 1971 is given. The energy available from municipal and organic wastes is given. The technologies involved in the conversion of these wastes are described. (DMC)

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 36638, 36639

36855 (DOE/PE—03871-01, pp 23.1-23.33) **Total energy systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The operation, energy conservation aspects, and economics of total energy systems in which rejected heat from on-site power generating equipment, i.e., steam turbines, gas turbines, or diesel engines, used for district or building-complex heating and cooling are discussed, and programs such as MIUS and ICES aimed at improving the technical options, economics, and desirability of total energy systems are described. (LCL)

CONSERVATION SERVICES

36856 Product positioning and competitive environment: the framework for a marketing strategy to promote energy conservation. McCrensky, J. (US DOE, Washington, DC). pp 925-929 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Approaching the promotion of conserving actions, investments, and behaviors with a marketing orientation, this paper gives an analysis of the marketing environment. From this, it gives such marketing concepts as product, competition, and positioning in an effort to develop a model to guide the market planning of diversified energy-conservation campaigns.

PUBLIC UTILITIES

36857 Community integrated cooling and heating system. Schaetzle, W.J.; Brett, C.E.; Grubbs, D.M. (Univ. of Alabama, University). pp 985-992 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The system described combines annual storage with water-source heat pumps for cooling and heating. Heat rejected in warm weather is stored for heating in cold weather. Natural aquifers provide the large annual thermal storage on an economical basis. The capital investment for storage consists of paired wells and two pumping systems. The system saves prime energy although the total capital cost is approximately the same as conventional systems. This cost balance is possible since the average cost of a water-source heat pump is below the average cost of an air-source heat-pump, and the capital cost of storage per home is only a fraction of heat pump capital cost. 8 refs.

36858 Evaluation of centralized energy systems for community growth: Shenandoah, Georgia. Wade, D.W. (Georgia Inst. of Technology, Atlanta). pp 993-1000 of Changing energy-use futures. Vol. 3. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Under a contract with the Department of Energy, a case study for energy-efficient project planning was conducted in parallel with preliminary planning for development of a 235-acre site which will be part of the first village in the development of the new town of Shenandoah, Georgia. The site will be multi-use and will include residential areas, commercial areas, institutional developments, and

recreational areas. One energy-conserving option available to the project developers is to integrate energy use through the construction of a central energy plant located on or adjacent to the site. This paper discusses the planning, technical aspects, and analyses involved in evaluating a central-plant approach to integrating community energy use at Shenandoah, Georgia.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 36205, 36611, 36854, 37078, 37222

36859 (DOE/R5/10110—2) **Digester gas utilization at West-Southwest Sewage Treatment Works. Final technical report.** (Metropolitan Sanitary District of Greater Chicago, IL (USA)). 1980. Contract FG02-79R510110. 7p. NTIS, PC A02/MF A01.

The physical site and operation of the West Southwest Sewage Treatment Works of the Metropolitan Sanitary District of Greater Chicago are described. Over a billion gallons of sewage is handled each day. Influent is screened to remove large debris, flows through preliminary settling tanks to separate most suspended and floating scum solids, passes through aeration tanks which assist biological decomposition of remaining impurities, and is allowed to settle again before chlorination and/or discharge to the waterway. Sludges collected during the process are mixed with scum and ground screenings, concentrated by gravity or mechanical means, and, in the case pertinent to the subject project, are fed to digestion tanks where the action of anaerobic bacteria generates heat and combustible gas, primarily methane. Digested sludge can be further concentrated and disposed of by application on strip mined land. Gas generated during anaerobic digestion has averaged approximately 2.7 million standard cubic feet per day. Of this amount, 1.7 million SCF per day is used keeping the digesters heated to the proper temperature for the bacteria to thrive. The excess 1.0 million SCF per day is piped from the digesters and burned to supply power for low pressure steam generator.

36860 **Closed loop waste treatment and water recycling toilet system .** Bernardin, F.; Coviello, A.; Kalb, K. (to Thetford Corp.). US Patent 4,210,528. 1 Jul 1980. Filed date 28 Feb 1979. vpp.

A description is given of a multi-stage method for treating toilet waste and recycling treated liquid therefrom, comprising the steps of; A. receiving said waste at a first stage and flushing said waste from said first stage with flush water containing nitrates thereby to form a liquid mixture of the waste and nitrate containing flush water, B. transferring said liquid mixture to a second stage whereby said mixture is agitated and is maintained under anoxic conditions so as to cause denitrification of said liquid mixture and generation of nitrogen gas, said nitrogen gas being vented from said second stage in such manner as to prevent the entry of oxygen into said second stage thereby to assist in maintaining the anoxic conditions in said second stage. C. transferring liquid from said second stage to a thrid stage containing biologically active solids and liquid and being maintained under aerobic conditions, air being passed through the mixture in said third stage at a sufficient rate to cause nitrification of nitrogenous compounds in said mixture, thereby to produce nitrates therein, the dissolved oxygen in the mixture in said third stage being greater than 2 mg/1, D. transferring the nitrate-containing mixture from said third stage directly to a filtering stage wherein said mixture is filtered to separate nitrate-containing water therein from the solids therein, the concentration of nitrate nitrogen in said nitrate-containing water being at least 50 mg/1, E. cycling solids from said filtering stage back to said third stage; and F. cycling said nitrate-containing water from said filtering stage to said first stage thereby to serve as said nitrate-containing flush water in said first stage.

36861 **Air emissions--controls and regulations affecting implementation of water tube wall incinerators.** Ball, D.A.; Engdahl, R.B.; Hummell, J. (Battelle, Columbus Lab, Ohio). *Proc. Air Pollut. Control Assoc.;* **1**: vp(1979).

This paper discusses current and past practices of emission controls for waterwall incinerators, highlighting the European experience which includes many successes in this area. This paper also discusses problems with current practices and areas where research and development are needed. 18 refs.

EDUCATION AND PUBLIC RELATIONS

36862 (DOE/CS/30292—3) **SOLPLAN.** (Wisconsin Center for Public Policy, Madison (USA)). 8 Aug 1980. Contract FG02-79CS30292. 13p. NTIS, PC A02/MF A01.

Recommendations developed at the Financing Residential Conservation Conference II are presented. Reactions were sought from the participants on the following: financial institution initiatives; utility initiatives; and state initiatives. A questionnaire lists a number of suggested alternatives for increasing energy conservation and the use of alternatives forms of energy within Wisconsin. Twenty-six suggestions are given.

36863 (ORAU—169) **Employment, education, and training implications of the National Energy Act.** Finn, M.G.; Stevenson, W.; Baker, J.G.; Blair, L.M.; Doggette, J.R. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Training Div.). Apr 1980. Contract AC05-76OR00033. 125p. NTIS, PC A06/MF A01.

The objective of the National Energy Act (NEA) is to slow the growth of demand and alter the energy supply mix in favor of abundant and renewable resources. Adjusting to such a change will require some important economic changes, including a reallocation of labor. This report identifies, where possible, the employment impacts of NEA. Special attention is given to areas in which an institutional response is necessary to provide needed education and training. Where information is inadequate or not available, recommendations for further research are made. The report is organized into two parts. Analysis of specific NEA provisions is presented in Part II. The first part provides background for this analysis. Part I gives a review of recent energy policy with a fairly extensive discussion of the NEA provisions to be investigated and the aggregate impact expected from recent energy policy is analyzed. Education and training implications of the NEA are presented in Part II for energy-related construction activities, coal conversion activities, energy conservation activities, solar energy activities, and miscellaneous activities (natural gas extraction, increased automobile efficiency, research and development, etc.).

36864 **Data-based management of government energy programs.** Sykes, D.J.; Stevens, W.F. (Michigan Energy Administration, Lansing). pp 307-314 of Changing energy-use futures. Vol. 1. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

During the month of August, 1977, the Michigan Department of Commerce through its Energy Administration received one of ten $1.1 million grants from the Energy Research and Development Administration (now the U.S. Department of Energy) for the development of an Energy Extension Service (EES). The Energy Extension Service's major objective is focused on public education, consumer affairs, Federal-state relations, along with encouraging community efforts to aid Michigan residents, and small-business people to conserve and manage their energy use efficiently. The Michigan EES is comprised of four major areas of activity; 1) Youth Energy Education Project, 2) Clearinghouse, 3) Special Project, and 4) the Small Business Project. 4 refs.

36865 **Solar energy curriculum for elementary schools: development, dissemination, and distribution.** Wulf, K.M. (Univ. of Southern California, Los Angeles). pp 708-710 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Since students now in elementary schools will be the sector of the world's population most directly affected by problems of energy depletion, it is appropriate immediately to provide them with programs dealing with concepts of solar energy. This project, then, aims to educate children in grades kindergarten through six toward two major goals: 1) an appreciation of the need for energy conservation, and 2) an understanding of the potential of the sun as a suitable alternative energy resource.

36866 **Assessment of youth energy-conservation attitudes and behavior: making it worthwhile.** Jeppesen, J.C.; Emshoff, M.D. (Michigan Energy Administration, Lansing). pp 884-891 of Changing energy-use futures. Vol. 2. Fazzolare, R.A.; Smith, C.B. (eds.). New York, NY; Pergamon Press (1979).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

Energy-education research could be utilized much more effectively if such research efforts were designed to provide usable information directly to the people in the schools who can implement policy based on the results of that research. In this way, practitioners in education could improve their planning for energy-conservation education through incorporation of well-tested educational techniques. This paper presents recommendations based on a Michigan Energy Extension Service project and is intended to assist those whose hope it is to make energy-education research more worthwhile. 3 refs.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 36833

36867 Air conversion for internal combustion engines . Plesko, E. US Patent 4,210,062. 1 Jul 1980. Filed date 14 Aug 1978. vpp.

A description is given of a conversion unit replacing spark plugs of a piston engine for operating the engine on pressurized gas, the engine having a plurality of pistons reciprocable in a compression stroke and an exhaust stroke in respective cylinders, the unit comprising: a source of compressed gas; a housing having a flow passage therethrough; an inlet port connected to said source and communicating pressurized gas from said source of pressurized gas into said housing; a drive valve in said housing opening and closing to flow of said pressurized gas through said housing; a sensor responsive to pressure down-stream of said drive valve and operably connected to said drive valve; and an outlet from said housing connected into the cylinder of a piston engine, above the piston, said outlet in communication with said sensor and said pressurized gas when said drive valve is open, said sensor causing said drive valve to open on the compression stroke of the pistons and to close on the exhaust stroke of said piston whereby the flow of said compressed gas is automaticaly timed.

36868 Internal combustion engine . Akishino, K.; Hori, K.; Kiyota, Y.; Nakagami, T.; Nakamura, H.; Ohinouye, T.; Tsukamoto, Y. (to Mitsubishi Jidosha Kogyo K K (Japan)). US Patent 4,210,104. 1 Jul 1980. Priority date 19 May 1976, Japan, vpp.

A description is given of an internal combustion engine comprising a cylinder, a cylinder head for said cylinder providing a combustion chamber having inlet and exhaust ports, a main inlet passage for supplying an air-fuel mixture formed by a mixture forming means to said inlet port, a throttle valve provided in said main inlet passage, a spark plug threadedly fixed in said cylinder head and having a spark gap disposed at a predetermined position in said combustion chamber, an injection chamber provided in the cylinder head close to said spark gap, an injection port providing communication between said combustion chamber and said injection chamber, said injection port being disposed near to said spark gap and being directed at said spark gap and transversely of the axis of said cylinder, a secondary inlet passage means communicating with said injection chamber, a secondary inlet valve positioned in advance of said injection chamber for opening and closing the secondary inlet passage means, and an opening mechanism for opening and closing said secondary inlet valve, said mechanism being operated so that said secondary inlet valve is open during substantially the entire suction stroke of the engine, said injection port being positioned to discharge gas in said injection chamber substantially toward said spark gap due to high negative pressure produced in said combustion chamber during a suction stroke of the engine, the discharge of gas from said port creating turbulence in said combustion chamber and scavenging previously formed exhaust gases from the region of said gap.

36869 Electronically controlled exhaust gas recirculation system in internal combustion engine. Nagaishi, H.; Nakamura, K. (to Nissan Motor Co Ltd (Japan)). US Patent 4,210,112. 1 Jul 1980. Priority date 28 Dec 1977, Japan, vpp.

A description is given of a system for recirculation of exhaust gas in an internal combustion engine provided with an intake passage and an exhaust passage, the system comprising: means for defining a recirculation passage interconnecting said exhaust passage to said induction passage to recirculate a portion of engine exhaust gas; a metering orifice of a fixed area formed in said recirculation passage; vacuum operated valve means for controlling an effective cross-sectional area of said recirculation passage at a section downstream of said metering orifice; pressure modulation means for modulating a vacuum produced in said induction passage with air based on a comparison between a signal negative pressure and an exhaust gas pressure in a control section of said recirculation passage between said metering orifice and said valve means thereby to produce a control negative pressure to operate said valve means; a conduit which connects said induction passage to said pressure modulation means to transmit said vacuum and has an air admission port opening into the atmosphere, said signal negative pressure being produced by modulation of a negative pressure in said conduit with atmospheric air admitted into said conduit through said air admission port; an electromagnetic valve provided to said conduit at a section between said induction passage and said air admission port so as to vary the magnitude of a negative pressure at said air admission port of said conduit thereby to vary the magnitude of said signal negative pressure; a plurality of sensors each for sensing a parameter of engine operating conditions and producing an electrical signal representing the sensed parameter; and electronic control means for providing a control signal to said electromagnetic valve to control the magnitude of said signal negative pressure and hence the magnitude of said control negative pressure.

SPARK-IGNITION

36870 Fuel system for and a method of operating a spark-ignited internal combustion engine. Dimitroff, E.; Vitkovits, J. (to Southwest Res Inst). US Patent 4,210,103. 1 Jul 1980. Filed date 4 Apr 1977. vpp.

A description is given of a fuel system for a spark-ignited internal combustion engine having an induction system in which gasoline may be atomized, an exhaust, and means for supplying gasoline to a carburetor in the induction system for atomization; the improvement comprising a thermal pyrolysis chamber in heat exchange relation with the exhaust gases, means for circulating a liquid hydrocarbon alcohol of from 1 to 3 carbon atoms through the chamber in order to dissociate said alcohol into vapors including hydrogen, carbon monoxide and carbon dioxide in the absence of compressed air and soley in response to such heat and without need for catalysts, and then supplying the vapors to the induction system for mixing with the atomized gasoline to provide a fuel for the engine.

36871 Internal combustion engine injected accumulation chamber. Ito, S.; Nohira, H.; Oki, H. (to Toyota Jidosha Kogyo K K (Japan)). US Patent 4,210,105. 1 Jul 1980. Priority date 17 Jan 1978, Japan, vpp.

A description is given of an internal combustion engine having an intake passage and an exhaust passage, comprising: a cylinder block having a cylinder bore therein; a cylinder head mounted on said cylinder block and having a fixed-volume, non-cooled cavity therein; a piston reciprocally movable in said cylinder bore; a combustion chamber formed between said cylinder head and said piston, said cavity having a port connected to said combustion chamber; an intake valve movably mounted on said cylinder head for leading a suction gas from the intake passage into said combustion chamber; an exhaust valve movably mounted on said cylinder head for discharging an exhaust gas into the atmosphere; means for feeding fuel into said cavity to create a combustible mixture therein, said feeding means comprising a fuel injector; a spark plug having a spark gap located in said combustion chamber; valve means for opening said port of the cavity once per cycle during the compression stroke to spout out a jet of the combustible mixture under pressure into said combustion chamber from said cavity during the first half of the compression stroke and permit the inflow of the suction gas into said cavity from said combustion chamber during the latter half of the compression stroke for temporarily accumulting the suction gas under pressure after said port is closed; and a fuel injection control device for starting the injecting operation of said fuel injector immediately after said valve means is closed.

TURBINE

36872 (AD-B—023566/3) Brittle materials design, high temperature gas turbine. Interior report no. 11, 1 Jul-31 Dec 76. McLean, A.F.; Fisher, E.A. (Ford Motor Co., Dearborn, MI (USA)). Aug 1977. Contract DAAG46-71-C-0162. 136p. NTIS, PC A07/MF A01.

The demonstration of uncooled brittle materials in structural applications at 2500 F is the objective of the 'Brittle Materials Design, High Temperature Gas Turbine' program. Ford Motor Company, the contractor, is utilizing a small vehicular gas turbine comprising an entire ceramic hot flow path including the highly stressed turbine rotors. Westinghouse, the subcontractor, originally planned to evaluate ceramic first stage stator vanes in an actual 30MW test turbine engine; however, this objective was revised to demonstrate ceramic stator vanes in a static test rig. Both companies had in-house research programs in this area prior to this contract. In the stationary gas turbine project, the test of ceramic stator vanes in a static rig for 100 cycles up to temperatures of 2500 F has been completed. This accomplishment meets the revised objectives for the stationary turbine project and, therefore, this project was completed. Fabrication of duo-density silicon nitride turbine rotors continued during this reporting period. The injection molding of duo-density rotor blade rings has been improved by the addition of a solid state automatic control system which was installed on the injection molding machine. Fabrication of turbine inlet nose cones and stators was resumed on a limited basis. In order to select the best method of processing Si3N4 powder, the optimum Mg0 content and the best hot pressure parameters consistent with the hub forming portion of the duo-density rotor process, a parametric processing study was conducted. A technique was developed which allows the furnace to control the nitriding dependent upon the nitrogen gas consumption rate, resulting in improved material structure.

36873 **Gas turbine engine braking and method .** Mattson, G.; Woodhouse, G. (to Garrett Corp The). US Patent 4,209,979. 1 Jul 1980. Filed date 22 Dec 1977. vpp.

A method is described of decelerating a ground vehicle driven by a gas turbine engine having a gas generator section and a free turbine output power section driven by a gas flow from the gas generator section, comprising the steps of: altering the incidence of gas flow from the gas generator section onto the free turbine section whereby said gas flow opposes rotation of the free turbine section; increasing gas generator section speed; and subsequent to said altering and increasing steps, selectively mechanically interconnecting said gas generator and free turbine sections whereby the rotational inertia of the gas generator section tends to decelerate the free turbine section.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

36874 (DOE/NASA/1040—15) **Creep-rupture behavior of seven iron-base alloys after long term aging at 760°C in low pressure hydrogen.** Witzke, W.R.; Stephens, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1980. Contract AI01-77CS51040. 38p. (NASA-TM—81534). NTIS, PC A03/MF A01.

Candidate iron-base alloys for heater tube application in the Stirling automotive engine were aged at 760°C for 3500 h in a low pressure argon or hydrogen atmosphere to determine the effect on mechanical behavior. The seven alloys evaluated were N-155, 19-9DL, 316SS, Nitronic 40, A286, Incoloy 800H, and RA330. Aging produced no appreciable changes in alloy grain size but did promote increased density and growth of precipitate particles in the grains and grain boundaries. Tensile properties were generally degraded by aging, with ductility and strength changes being influenced by grain structure. Aging also decreased creep-rupture strength, with coarse grain materials being more susceptible to strength loss. The presence of hydrogen during aging did not contribute significantly to creep strength degradation in the coarse grain alloys but did result in extensive strength losses in fine grain alloys. Based on current criteria for the Mod I Stirling engine, the N-155 and 19-9DL alloys were the only alloys in this study with strengths adequate for heater tube service at 760°C.

36875 **Wobble plate engine .** Derderian, H.; Pronovost, J. (to ECO Motor Ind Ltd Canada). US Patent 4,209,980. 1 Jul 1980. Filed date 11 May 1979. vpp.

A description is given of a conventional Stirling cycle engine of the type characterized by an elongated cylinder having a closed end and an open end, means for applying heat to the exterior of the cylinder to heat gas in the interior of the cylinder at the closed end thereof, a displacer piston mounted for a reciprocation within the closed end of the cylinder and a power piston axially aligned with the displacer piston and mounted for coaxial reciprocation between the displacer piston and the open end of the cylinder, the reciprocation of the displacer piston leading the corresponding stroke of the power piston by a predetermined phase angle, the improved means for properly phasing the reciprocation of the two pistons and for converting the reciprocation of the power piston into rotation of an output shaft which is parallel to the axis of reciprocation comprising: a supporting frame; an output shaft mounted on said frame for rotation about a first axis which is parallel to the axis of reciprocation of the two pistons, said shaft having an inclined cylindrical bearing surface the axis of which intersects said first axis at an acute angle; gimbal means pivotally mounted on said supporting frame for oscillation about a second axis perpendicular to and intersecting first axis; a wobble plate pivotally mounted on a third axis within said gimbal means for oscillation with said gimbal means and for further oscillation about said third axis which is mutually perpendicular to and intersecting said first and second axes, said wobble plate being rotatably mounted on said inclined cylindrical bearing surface in a plane which is perpendicular to said axis of said bearing surface whereby said output shaft can rotate about said first axis as said wobble plate oscillates about said second and third axes.

ELECTRIC-POWERED SYSTEMS

36876 (DOE/CS—0026/11) **Electric and hybrid vehicle program. Quarterly report, April, May, June 1980.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Aug 1980. 31p. NTIS, PC A03/MF A01.

Progress in the design, commercialization, performance, fuel economy, production and demonstration of electric vehicles and hybrid electric-powered vehicles is reported. (LCL)

36877 (DOE/NASA/0124—2) **Small passenger car transmission test: Ford C4 transmission.** Bujold, M.P. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Jun 1980. Contract AI01-77CS51044. 336p. (NASA-CR—159881). NTIS, PC A15/MF A01.

The small passenger car transmission test was initiated to supply electric vehicle manufacturers with technical information regarding the performance of commercially available transmissions. This information would enable EV manufacturers to design a more energy efficient vehicle. With this information the manufacturers would be able to estimate vehicle driving range as well as speed and torque requirements for specific road load performance characteristics. This report covers the 1979 Ford C4 automatic transmission. This transmission was tested per a passenger car automatic transmission test code (SAE J651b) which required drive performance, coast performance, and no load test conditions. Under these test conditions the transmission attained maximum efficiencies in the mid-80% range for both drive performance tests and coast performance tests. The major results of this test are the torque speed and efficiency curves which are located in the data section of this report. These graphs map the complete performance characteristics for the Ford C4 transmission. This information will facilitate the vehicle manufacturer in the design of a more energy efficient vehicle.

36878 (DOE/NASA/0124—3) **Small passenger car transmission test: Chevrolet Luv transmission.** Bujold, M.P. (Eaton Corp., Southfield, MI (USA). Engineering and Research Center). Jun 1980. Contract AT01-77CS51044. 415p. (NASA-CR—159882). NTIS, PC A18/MF A01.

The small passenger car transmission test was initiated to supply electric vehicle manufacturers with technical information regarding the performance of commercially available transmissions. This information would enable EV manufacturers to design a more energy efficient vehicle. With this information the manufacturers would be able to estimate vehicle driving range as well as speed and torque requirements for specific roadload performance characteristics. This report covers the 1978 Chevrolet Luv Truck manual transmission. This transmission was tested per a passenger car automatic transmission test code (SAE J65lb) which required drive performance, coast performance, and no load test conditions. The portion of the test code which involved the throttle valve modulation and line pressure were deleted since they did not apply to the manual transmission. Under these test conditions the transmission attained maximum efficiencies in the upper 90% range at rated load for both drive performance tests and coast performance tests. The major results of this test are the torque speed and efficiency curves which are located in the data section of this report. These graphs map the complete performance characteristics for the Chevrolet Luv Truck Manual transmission. This information will facilitate the vehicle manufacturer in the design of a more energy efficient vehicle.

36879 (DOE/NASA/1011—32) **Laboratory facility for electric vehicle propulsion system testing.** Sargent, N.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-76CS51011. 11p. (NASA-TM—81574; CONF-800939—1). NTIS, PC A02/MF A01.

From International congress on transportation; Dearborn, MI, USA (15 Sep 1980).

The Road Load Simulator Facility located at the NASA Lewis Research Center in Cleveland, Ohio is described. This facility enables a propulsion system or any of its components to be evaluated under realistic vehicle inertia and road loads. The load is applied to the system under test according to the road load equation: F/sub net/ $= K_1F_1 + K_2F_2V + K_3V^2 + K_4\,(dv/dt) + K_5 \sin\theta$. The coefficient of each term in the equation can be varied over a wide range with vehicle inertia representative of vehicles up to 7500 lb. simulated by means of flywheels. The required torque is applied by the flywheels, a hydroviscous absorber and clutch, and a drive motor integrated by a closed loop control system to produce a smooth, continuous load of up to 150 horsepower.

36880 (UCID—18754) **System for acquisition and reduction of demonstration data for electric vehicles.** Lorbeer, E.H.; Walter, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1980. Contract W-7405-ENG-48. 116p. NTIS, PC A06/MF A01.

Congress seeks to reduce petroleum consumption by encouraging the use of electric vehicles and has legislated an Electric and Hybrid Vehicle Demonstration project. In carrying out this mandate, DOE developed a data plan to assess the Demonstration project. The Data Aquisition and Reduction Module (DARM) System was developed by LLNL for use on demonstration electric vehicles to determine reliably and inexpensively quantitative data on their performance. The DARM System consists of an instrumentation unit which is installed in selected demonstration vehicles, a tape reader, and data reduction programs. Once the on-board DARM unit is installed, the vehicle operator needs only to insert and remove cassette tapes at intervals of up to three months. The tapes can be reduced with the specialized reduction programs, entered into a data base, and the data subjected to analysis at a Data Reduction Center.

DARM povides data on energy consumption (into and out of the battery), distance and time travelled, and number of stops experiences. A profile of energy consumption and time spent as a function of speed and acceleration allows deduction of driver satisfaction and provides direction to designers for improving electric vehicle performance.

36881 **Battery charging systems for road vehicles .** Taylor, J. (to Lucas Industries Ltd UK). US Patent 4,210,856. 1 Jul 1980. Priority date 2 Apr 1977, United Kingdom of Great Britain and Northern Ireland (UK), vpp.

A description is given of a battery charging system for a road vehicle comprising an alternator, a rectifier connecting the alternator to a main battery for charging thereof by the alternator, a voltage regulator connected to the alternator and operating to control the output voltage of the alternator, and a d.c. to d.c. converter connecting the main battery to an auxiliary battery which is in series with the main battery, the d.c. to d.c. converter including a pair of semiconductor switching elements, an auto-transformer having a pair of main windings, each connected at one end to one terminal of the main battery and connected at its other end through a respective one of said semi-conductor switching elements to the other terminal of the main battery, said switching elements forming part of an oscillator so that the switching elements are turned on alternately, a diode, and at least one further winding connected in series with said diode between said other end of one of the main windings and a terminal of the auxiliary battery.

36882 (DOE-tr—234) **Rectifier electric drive for an electric automobile using a non-contact synchronous motor with permanent magnets.** Yapuk, V.G. [nd]. Translated from 2nd Soviet-American symposium on electric automobiles; Erevan, USSR, 1979. 7p. NTIS, PC A02/MF A01.

A traction electric drive for an electric automobile (EA) using a rectifier electric drive (RED) is being developed due to the number of advantages which it has over other types of electric drives. The possibility for designing a compact engine reveals the promise for developing a motor-wheel of a multimotor modification which will make it possible to improve the flexibility of the control and the reliability of the drive of an electric automobile. The basic technical requirements determined by the specifics of designing and developing a motor are: high ratios of torque when accelerating and climbing, high efficiency in a wide rpm range and limited weight and size with minimal possibilities for cooling and rigid operating conditions. The use of high-energy permanent magnets made of rare-earth elements has made it possible to develop a motor which provides the required operating modes and performance at the required size. The design of a developed motor is discussed.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 36876, 36877

36883 (DOE/JPL/955189—T2) **Preliminary design data package. Appendices C1 and C3.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 25 Jul 1979. Contract NAS-7-100-955189. 217p. NTIS, PC A10/MF A01.

The computer programs, including HYBRID, VSYS, VEHIC and CRASH, used to compute the energy and fuel consumption, life-cycle costs and performance characteristics of a hybrid electric-powered vehicle are described and their use documented. (LCL)

36884 (DOE/JPL/955189—T3) **Preliminary design data package. Appendix C.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 25 Jul 1979. Contract NAS-7-100-955189. 237p. NTIS, PC A11/MF A01.

The design requirements, design philosophy, method and assumptions, and preliminary computer-aided design of the Near-Term Hybrid Vehicle including its electric and heat power units, control equipment, transmission system, body, and overall vehicle characteristics are presented. (LCL)

36885 (DOE/JPL/955189—T4) **Design tradeoff studies and sensitivity analysis. Appendices B1-B4.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 25 May 1979. Contract NAS-7-100-955189. 187p. NTIS, PC A09/MF A01.

These four appendices to the report on the Near-Term Hybrid Vehicle (NTHV) report contain information on: HYBRID computer program documentation; material substitution study for advanced hybrid vehicles; NTHV market potential; battery compartment weight distribution; and vehicle handling dynamics. (LCL)

36886 (DOE/JPL/955189—T5) **Mission analysis and performance specification studies report. Appendix A.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 25 Jan 1979. Contract NAS-7-100-955189. 171p. NTIS, PC A08/MF A01.

The results of Task I, mission analysis and performance specifications, for the Near-Term Hybrid Vehicle (NTHV) development program are presented. The items researched included trip characteristics, market potential, life-cycle cost and performance specifications of NTHV's. (LCL)

36887 (DOE/JPL/955189—T6) **Phase I of the Near-Term Hybrid Vehicle Program. Final report.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 10 Sep 1979. Contract NAS-7-100-955189. 154p. NTIS, PC A08/MF A01.

Heat engine/electric hybrid vehicles offer the potential of greatly reduced petroleum consumption, compared to conventional vehicles, without the disadvantages of limited performance and operating range associated with pure electric vehicles. This report documents a hybrid vehicle design approach which is aimed at the development of the technology required to achieve this potential, in such a way that it is transferable to the auto industry in the near term. The development of this design approach constituted Phase I of the Near-Term Hybrid Vehicle Program. The major tasks in this program were: mission analysis and performance specification studies; design tradeoff studies; and preliminary design. Detailed reports covering each of these tasks are included as appendices to this report. A fourth task, sensitivity studies, is also included in the report on the design tradeoff studies. Because of the detail with which these appendices cover methodology and results, the body of this report has been prepared as a brief executive summary of the program activities and results, with appropriate references to the detailed material in the appendices.

36888 (DOE/JPL/955190—T1) **Near-Term Hybrid Vehicle Program, Phase I. Appendix D. Sensitivity analysis report. Final report.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 81p. NTIS, PC A05/MF A01.

The study methodology, the selection of input parameters and output variables, the sensitivity study results, and the conclusions of the sensitivity analysis for the Near-Term Hybrid Vehicle (NTHV) Program are presented. The objective of the Sensitivity Analysis was to determine the impact of variations in selected parameters on the utility, the economic attractiveness, and the marketability of the hybrid vehicle. The parameters to be varied include travel characteristics, energy costs, hybrid vehicle lifetime, maintenance costs, and fuel economy of the Reference ICE Vehicle. The results of the study are presented in terms of how the design variables affect each of these aspects of the NTHV. (LCL)

36889 **Internal electric explosion engine .** Sokol, B. US Patent 4,209,983. 1 Jul 1980. Filed date 26 Mar 1979. vpp.

A description is given of an internal electric explosion engine, comprising: a vessel having a plurality of interior spaces with inlet and outlet means for respectively introducing a fluid into said spaces at relatively low pressure and removing said fluid from said spaces at relatively high pressure, said spaces serving as explosion chambers; electric discharge explosion in situ means comprising spaced electric discharge elements disposed in each of said explosion chambers, said discharge means further including means for applying electrical potential of opposite polarities to said discharge elements; a fluid; storage means for holding said fluid under pressure; conduit means for recirculating said fluid between said vessel and said storage means; drive means adapted to be driven by said pressurized fluid so as to do work; said vessel, said explosion means, said storage means and said conduit means forming a closed loop fludic pressure system; wherein said discharge means is adapted to explode in said fluid within said vessel said exploded fluid expanding in volume to increase the internal pressure in said system providing said pressurized fluid whereby said drive means is driven.

FLYWHEEL PROPULSION

36890 (UCRL—15280) **Flywheel energy storage unit technology development program.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jun 1980. Contract W-7405-ENG-48. 212p. NTIS, PC A10/MF A01.

A program to demonstrate an improved flywheel energy storage unit (ESU) to be used in combination with a heat engine for propelling a 1985 family sedan is described. Information is included on flywheel ESU design criteria, design, stress analysis thermal analysis, and performance. The ESU was designed, fabricated, and partially evaluated prior to the program being discontinued by LLL because of electrical machine failures and insufficient funds to correct the hardware discrepancies. (LCL)

VEHICLE DESIGN FACTORS

REFER ALSO TO CITATION(S) 36887

ENGINE-TRANSMISSION MATCHING

REFER ALSO TO CITATION(S) 36877, 36878

EMISSION CONTROL

REFER ALSO TO CITATION(S) 36868, 36869

36891 Method and an apparatus to control the temperature of an engine exhaust gas purifying device. Masaki, K.; Miyamori, Y. (to Nissan Motor Co Ltd (Japan)). US Patent 4,209,981. 1 Jul 1980. Priority date 16 May 1975, Japan, vpp.

A description is given of an internal combustion engine having an induction system including an air-fuel mixture forming means, a combustion chamber, an exhaust system including an exhaust purifying device and an exhaust gas recirculation system interconnecting said induction and exhaust systems, a method of rapidly raising and lowering the temperature in said prifying device between a predetermined upper temperature and a predetermined lower temperature comprising the steps of: recirculating exhaust gas from said exhaust system to said induction system for lowering the peak combustion temperature in said combustion chamber; sensing the temperature prevailing in said purifying device; generating a first command signal when said temperature in said purifying device is sensed at or below said lower temperature and continuing to generate said command signal until said temperature in said purifying device rises to said upper temperature; generating a second command signal when said temperature in said purifying device is sensed at or above said uper temperature and continuing to generate said second command signal until said temperature in said purifying device decreases to said lower temperature; raising the temperature in said purifying device in response to said first command signal by: enriching the air-fuel mixture produced by said air-fuel mixture forming means; retarding the ignition timing of the ignition of said enriched air-fuel mixture in said combustion chamber; supplying secondary air into said exhaust system upstream of said purifying device; and producing sparking in said purifying device so as to positively ignite the large amount of combustible matter issuing from said combustion chamber due to said retarded ignition and enriched air-fuel mixture thus negating the effect of the lowering of the peak combustion temperature.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 35939, 36870

MATERIALS

MATERIALS

REFER ALSO TO CITATION(S) 36966

36892 (LBL—10000) **Materials and Molecular Research Division annual report 1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 565p. NTIS, PC A24/MF A01.

Research is presented concerning materials sciences including metallurgy and ceramics, mechanical and physical properties, and engineering materials; solid state physics; materials chemistry; chemical sciences covering photochemical and radiation science, chemical and atomic physics; nuclear science; fossil energy; advanced isotope separation; and energy storage. (FS)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 36296, 36986

36893 (AD-A—080078/9) **Ion implantation in perovskite type ferroelectrics. Progress report No. 6 (final), 1 Nov 76-31 Oct 79.** Gerson, R. (Missouri Univ., Rolla (USA)). 20 Dec 1979. 15p. NTIS, PC A02/MF A01.

The object of this work was to study ion implantation in perovskite ferroelectrics and to investigate the conductive behavior of implanted layers. Implantation experiments were carried out on strontium titanate, barium titanate (single crystal and ceramic), titanium dioxide (rutile), lithium niobate, and lithium tantalate. Ion beams attempted were H(+), B(+), C(+), N(+), Fe(+), Ar(+), As(+), Ta(+), and Nb(++). In general the most effective ion in producing conductivity was boron, B(+). Significant conductivity was measured in the substrates above, except for single crystals of barium titanate and lithium tantalate. Boron implanted in strontium titanate and subsequently annealed resulted in highly conductive layers, whose sheet resistance could be between 100 and 100,000 ohm per square. The charge carrier mobility in this system was 5 sq. cm/volt sec at room temperature, increasing to 100 sq. cm/volt sec at 77 K. Implantation doses were 10 to the 16th power to 10 to the 17th power ions/sq. cm. The implantation depth, as revealed by chemical stripping experiments, was about 500 nm. A conductive anomaly was measured in some samples at 105 K, the cubic-tetragonal transition temperature.

36894 (LBL—10000, pp 7-163) **Materials sciences: metallurgy and ceramics.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Progress is reported on research in metallurgy and ceramics including structure of materials, mechanical and physical properties, and engineering materials. (FS)

36895 (ORNL—5670) **Metals and Ceramics Division. Annual progress report, ending June 30, 1980.** (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01.

Research is reported concerning: (1) engineering materials, including materials compatibility, mechanical properties, nondestructive testing, pressure vessel technology, and welding and brazing; (2) fuels and processes consisting of ceramic technology, fuel cycle technology, fuels evaluation, fuel fabrication and metals processing; and (3) materials science which includes, ceramic studies, physical metallurgy properties, radiation effects and microstructural analysis, metastable and superconducting materials, structure and properties of surfaces, theroretical research and x-ray research and applications. Highlights of the work of the metallographic group and the current state of the High-Temperature Materials Laboratory (HTML) and the Materials and Structures Technology Management Center (MSTMC) are presented. (FS)

36896 (RFP-Trans—287) **Behavior of nitrogen in electron-beam melting of vanadium; determination of nitrogen (in vanadium).** Gottwald, H.J.; Krone, K.; Krueger, J. Translated from *Metall;* **23**: No. 12, 1284-1289(1969). 15p. NTIS, PC A02/MF A01.

The outgassing of nitrogen and oxygen from vanadium is discussed, taking the literature into consideration. The amount of dissolved oxygen can be decreased by melting in a high vacuum, whereas the dissolved nitrogen approaches a limiting value of 0.3% by weight. For lower initial concentrations of nitrogen the concentration of nitrogen in the molten mass increases; at higher initial nitrogen concentrations partial outgassing takes place. Results of the investigation of vanadium in the molten state at about 2100°C are in rather good agreement with values extrapolated from the results of Hoerz for vanadium in the solid state. Various methods of nitrogen determination are discussed. In experiments the best results were obtained with the Pt-capsule method and the Pt-capsule plus Pt-bath method.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 36048, 36463, 36934

36897 (LBL—11222) **Binary and ternary niobium-base superconductors by the infiltration process.** Pickus, M.R.; Holthius, J.T.; Rosen, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01.

This report summarizes the work on high field superconducting materials and processes performed at the Materials and Molecular Research Division of the Lawrence Berkeley Laboratory. Two major interrelated focal points characterize this research. One was the decision to restrict the effort to A-15 compounds because of their superior critical temperatures and critical fields. The inherent brittleness of these compounds along with the requirement for a filamentary morphology led to the second focal point: a heavy reliance on a powder approach for the fabrication of superconducting tapes and wires. There have been exceptions to the use of powder techniques where special circumstances such as the nature of a particular alloy system suggested on alternative approach. The quench-age technique described herein is an example of a non-powder approach. Here the niobium-aluminum system is involved and the methodology is based on the fact that in a certain composition range a solid solution of aluminum in niobium is the stable phase at elevated temperatures (1950°C), whereas at lower temperatures (< 1100°C) the stable phase is the desired A-15 compound. Additionally, niobium forms deformation twins which were found to be effective sites for the nucleation of the A-15 phase.

36898 Preparation of Cu-Nb alloys for multifilamentary in situ superconducting wire. Verhoeven, J.D.; Gibson, E.D.; Schmidt, F.A.; Finnemore, D.K. (Ames Lab., IA (USA); Iowa State Univ. of

Science and Technology, Ames (USA). Dept. of Physics). *J. Mater. Sci.;* **15**: No. 6, 1449-1455(Jun 1980).

A study has been made of two techniques, chill casting and consumable arc melting, for preparing ingots of Cu-Nb alloy for production of multifilamentary Nb_3Sn superconducting wire. It was found that Y_2O_3, ThO_2 and graphite all make excellent crucible materials for melting Cu-Nb alloys at 1850°C. Some difficulty was found with Nb segregation in chill-cast 5 cm diameter ingots. The consumable arc casting technique was shown to produce a uniform Nb dendrite distribution with little macrosegregation in 5 cm diameter castings and is regarded as having excellent potential for scale-up production of uniform Cu-Nb ingots of 25 to 30 cm diameter.

36899 Method for preparing porous metal hydride compacts. Ron, M.; Gruen, D.M.; Mendelsohn, M.H.; Sheft, I. (to Dept. of Energy). US Patent Application 113,873. 21 Jan 1980. 13p.

A method for preparing porous metallic-matrix hydride compacts which can be repeatedly hydrided and dehydrided without disintegration. A mixture of a finely divided metal hydride and a finely divided matrix metal is contacted with a poison which prevents the metal hydride from dehydriding at room temperature and atmospheric pressure. The mixture of matrix metal and poisoned metal hydride is then compacted under pressure at room temperature to form porous metallic-matrix hydride compacts.

36900 Capillarity effects in the GTA weld penetration of 21-6-9 stainless steel. Roper, J.R. (Rockwell International, Golden, CO); Olson, D.L. *Weld. J. Res. Suppl.;* 5(Apr 1978).

Although the factors affecting weld penetration have often been investigated, the mechanisms of penetration are not well defined. 21-6-9 stainless steel, due to its transitional weld penetration behavior in the presence of aluminum, has afforded an unusual opportunity to study at least one of the factors affecting fusion zone shape. This penetration change is being studied from the interfacial energy viewpoint, and a model is proposed to account for the observed phenomena.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 36897, 36930

36901 Heterogeneous precipitation of MC carbides on extrinsic stacking faults in V-Co-Fe ordered alloys. Carpenter, R.W.; Braski, D.N. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. pp 648-649 of Thirty-seventh annual proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). San Antonio, TX; Electron Microscopy Society of America (1979).

The precipitate morphology on extrinsic stacking faults is described. Lattice expansion caused by the fault partially relieves the large position misfit of the precipitate. The fault edge is the preferred nucleation site. (FS)

36902 (NBS-SP—496(Vol.1)) **Applications of phase diagrams in metallurgy and ceramics.** Carter, G.C. (ed.). (National Bureau of Standards, Washington, DC (USA)). Mar 1978. 770p. (CONF-770116—(Vol.1)). GPO.

From Workshop on application of phase diagrams in metallurgy and ceramics; Gaithersburg, MD, USA (10 Jan 1977).

The Workshop assessed the current national and international status of phase diagram determinations and evaluations for alloys, ceramics, and semiconductors; to determine the needs and priorities for phase diagram determinations and evaluations; and to estimate the resources being used and potentially available for phase diagram evaluation. These proceedings reflect the detailed contents of the Workshop including critical phase diagram availability, user needs of phase diagrams, experimental methods of determination, theoretical methods of calculation and prediction, methods of phase diagram representations of calculation and prediction, methods of phase diagram representations (especially multicomponent) and distribution to the user. Three of the panels addressed the subject of phase diagram needs in industrial applications. These proceedings represent documentation of this assessment, and constitute a valuable resource to workers in these areas, especially those planning to initiate phase diagram programs. Most subjects within the overall scope have been dealt with substantially in these proceedings; a few specialized topics such as surface and small particle phases, needed for the study of catalysis, have not been treated in detail. As the Alloy Data Center maintains a continuing phase diagram program, we would like to receive suggestions for similar topics of current and future interest, descriptions of new needs, or addenda and corrigenda to these proceedings. Volume 1 presents the present status of compilation activities.

36903 (NBS-SP—496(Vol.2)) **Applications of phase diagrams in metallurgy and ceramics.** Carter, G.C. (ed.). (National Bureau of Standards, Washington, DC (USA)). Mar 1978. 851p. (CONF-770116—(Vol.2)). GPO.

From Workshop on application of phase diagrams in metallurgy and ceramics; Gaithersburg, MD, USA (10 Jan 1977).

The workshop represents an effort to coordinate and reinforce the current efforts on compilation of phase diagrams of alloys and ceramics. Many research groups and individual scientists throughout the world are concerned with phase equilibrium data. Specialized expertise exists in small institutions as well as large laboratories. If this talent can be effecively utilized through a cooperative effort, the needs for such data can be met. The Office of Standard Reference Data, which serves as the program management office for the National Standard Reference Data System, is eager to work with all groups concerned with this problem. Through a cooperative international effort we can carry out a task which has become too large for an individual. Volume 2 presents computational techniques for phase diagram construction.

36904 (ND-R—455(R)) **Metallographic techniques for the measurement of grain boundary precipitate in Type 316 stainless steel.** Slattery, G.F.; O'Riordan, P.; Lambert, M.E. (UKAEA Risley Nuclear Power Development Labs.). Apr 1980. 20p. NTIS (US Sales Only), PC A02/MF A01.

The effect of thermal ageing at 625°C on the intergranular precipitation in Type-316 austenitic steel has been studied using optical Nomarski interference contrast technique and scanning electron microscopy with a high brightness lanthanum hexaboride cathode. Quantitative data are presented on the complex distributions of the carbide particle size and spacing produced by thermal ageing. The distribution patterns change with time and after long times coarser intermetallic particles are formed in addition to the carbide and these extend the distribution curves. Chemical etching of the specimen surface can lead to erroneous measurements due to pitting around the particles and measurements should preferably be made on as-polished specimens. Difficulties of imaging the particles as-polished can be avoided by the use of Nomarski technique optically and the LaB_6 gun in the SEM.

36905 (SAND—80-1617C) **Substitutional nitrogen in laser-annealed ion-implanted silicon.** Brower, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-800961—1). NTIS, PC A02/MF A01.

From 11. international conference on defects and radiation effects in semiconductors; Oiso, Japan (8 Sep 1980).

Deep-level N donors introduced by ion implantation and laser annealing are observed for the first time with EPR. Unlike the shallow group V donors, N has a donor level near the middle of the bandgap and exhibits a Jahn-Teller trigonal distortion as measured by EPR. This N center undergoes structural changes above ≅ 400°C which are believed to be the first steps in the formation of silicon-nitride precipitates in silicon.

36906 Local fields near a point-charge defect in cubic ionic crystals. Wang, J.C. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2725-2730(15 Sep 1980).

Local fields (E/sub loc/) at ions near a point-charge defect in some cubic ionic crystals have been accurately calculated with a polarizable-rigid-ion model. The ratio E/sub loc//r^2 for ions at a distance r from the defect, plotted as a function of r, shows interesting oscillations about a horizontal line derived from the Clausius-Mossotti relation. For small r the orientations of E/sub loc/ also fluctuate about the radial directions. Both the oscillations and angular fluctuations diminish rapidly with r and become negligible when r is beyond 20 A. The implications of the results for defect-formation and diffusion-energy calculations for ionic crystals are discussed.

36907 Solute trapping of hydrogen in niobium; symmetry of the O-H pair. Zapp, P.E.; Birnbaum, H.K. (Univ. of Illinois, Urbana-Champaign). *Acta Metall.;* **28**: No. 9, 1275-1286(Sep 1980).

Anelastic relaxation techniques in the MHz frequency range were used to study the structure of the O-H pair in niobium and to determine its characteristic relaxation modes. Internal friction peaks were observed for longitudinal stress waves propogating in the <100>, <110> and <111> and two activation enthalpies of motion were measured; 0.18 eV in the <100> and 0.12 eV in the <111>. The apparent binding enthalpies for the two principal relaxations were the same, 0.1 eV. These results are interpreted in terms of the motion of hydrogen around an oxygen interstitial trapping site. The relaxation symmetries are related to the reorientations of nearest neighbor O-H pairs with <100> monoclinic symmetry second nearest neighbor pairs with <100> monoclinic symmetry and third nearest neighbor pairs with <110> monoclinic symmetry. Relations for the relaxation times in terms of atomic jump frequencies along specific reaction paths are developed. The measured parameters are related to the motion of hydrogen along these paths.

36908 Calculation of the lattice distortion due to carbon in α-iron. Hall, B.O. (Westinghouse R & D Center, Pittsburgh, PA). *Metall. Trans., A;* **11**: No. 8, 1315-1321(Aug 1980).

A method for calculating the static displacements of lattice atoms near a defect atom is presented and applied to carbon occupying the octahedral site in α-iron. The interaction between lattice atoms and the defect is assumed to extend to second neighbors, but a defect-lattice atom interatomic potential is neither assumed nor constructed. Instead the displacements of the first and second neighbors of the defect atom are treated as adjustable parameters, which can be determined experimentally, and the displacement field is calculated as a function of these parameters. A central, two-body Morse potential is used to describe the interaction of lattice atoms, and the lattice atom displacements are calculated for both harmonic and anharmonic (quartic) approximations of the potential. The latter calculation requires an iterative procedure that obtains self-consistent anharmonic displacements without sacrificing the convenience of the matrix inversion technique that is used to solve the harmonic problem.

36909 Analytical electron microscopy of stainless steel weld metal. Lyman, C.E. (Rensselaer Polytechnic Inst., Troy, NY). *Weld. J. Res. Suppl.;* 6(Jul 1979).

From AWS 60th annual meeting; Detroit, MI, USA (2 Apr 1979).

The technique of analytical electron microscopy in a Scanning Transmission Electron Microscope (STEM) fitted with an x-ray spectrometer is described. This high spatial resolution microanalysis technique is applied to duplex Type 304L stainless steel weld metal. Small inclusions in these steels may be either iron-rich or manganese-rich silicates and may contain small amounts of elements not listed in the normal chemical analysis. Chromium depletion at the data ferrite/austenite interface was found to be only 0.5 wt % Cr to a spatial resolution of 30 nm. This depletion is unlikely to be the cause of pitting corrosion observed at the δ/γ phase boundary. Cr and Ni composition profiles between delta ferrite regions show that Type 304L transforms on cooling from delta ferrite to austenite by a massive transformation.

36910 Misfit dislocations in (111) Pd/(111) Cu Bilayers. Chao, S.S.; Vook, R.W. (Syracuse Univ., NY). Contract EG-77-S-02-4496. pp 464-465 of Proceedings. Bailey, G.W. (ed.). San Antonio, TX; Electron Microscopy Society of America (1979).

From 37. annual Electron Microscopy Society of America conference; San Antonio, TX, USA (1979).

Misfit dislocations were present in the earliest stages of epitaxial growth (111) Pd on (111) Cu at 25°C. Pd and Cu have a natural lattice misfit $f_0 = (a/\text{sub } s/^0 - a_0{}^0)/a_0{}^0$ of 7.07%, where a/sub s/^{0} and $a_0{}^0$ are the unstrained lattice parameters of the substrate and overgrowth respectively. Three different kinds of misfit dislocations were observed and their corresponding Burgers vectors were determined.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 35921, 36874, 36937, 37116, 37119, 37436, 37449

36911 (DOE/ER/10475—T1) **Study and modeling of high temperature fatigue crack propagation in austenitic stainless steel. Progress report for 1980.** Davidson, D.L. (Southwest Research Inst., San Antonio, TX (USA)). 1 Sep 1980. Contract AS05-79ER10475. 17p. NTIS, PC A02/MF A01.

The preparation of equipment and the refining of experimental techniques for the determination of crack tip plasticity under cyclic conditions at high temperature was emphasized. Part of the equipment is now completed and part remains to be completed. With what is now ready, the part of the experimental investigaton originally proposed for the first year should be substantially completed by the end of that contract period.

36912 (ND-R—448(R)) **Relationship between creep crack growth rates and creep-fatigue crack growth rates in austenitic Type-316 steel.** Lloyd, G.J. (UKAEA Risley Nuclear Power Development Labs.). Mar 1980. 21p. NTIS (US Sales Only), PC A02/MF A01.

The relationship between high temperature crack growth rates in Type 316 steel under creep conditions and combined creep-fatigue cycling is examined by consideration of the similarities between the underlying physical mechanisms of crack advance. In this way it is shown that creep crack growth rates may be used to estimate the limits to which creep-fatigue cycling can cause crack growth rates to accelerate in this steel. The usefulness of the derived limit is discussed with particular reference to practical stressing modes including load and displacement control. It is concluded that in Type 316 steel there is little difference between the behavior of a crack propagating under combined creep-fatigue cycling and a creep crack growing under some restraint.

36913 Fracture of niobium hydride. Gahr, S.; Makenas, B.J.; Birnbaum, H.K. (Univ. of Illinois, Urbana-Champaign). *Acta Metall.;* **28**: No. 9, 1207-1213(Sep 1980).

Consideration is given to causes for the extreme brittleness observed for most hydrides. Surface energies for cleavage of the β NbH/sub 0.82/ f.c. orthorhombic hydride along the (100)/sub c/ and (110)/sub c/ are obtained using fracture mechanics methods. The values are shown to be about equal to those of b.c.c. niobium. The relative surface energies of niobium and NbH are consistent with measurements of phonon frequencies and elastic constants. None of the data indicates any decrease of atomic bonding due to the incorporation of hydrogen in the metal lattice. Dislocation mobility is considered on the basis of T.E.M. observations and the crystal structure. It is shown that half of the (110)/sub c/<111>/sub c/ slip systems cause hydrogen disordering and therefore experience a high lattice frictional stress. Domain boundaries also are shown to be dislocation barriers. Hydride brittleness is considered to result from the decrease in dislocation mobility and in the slip systems available to cause plastic blunting at elastic discontinuities.

36914 Substructure and strengthening mechanisms in 2.25 Cr-1 Mo steel at elevated temperatures. Jones, W.B.; Van Den Avyle, J.A. (Sandia National Labs., Albuquerque, NM). *Metall. Trans., A;* **11**: No. 8, 1275-1286(Aug 1980).

The substructures of thermally aged, creep deformed and fatigued 2.25 Cr-1 Mo steel have been studied using optical and transmission electron microscopy. In agreement with earlier work, the substructure of the proeutectoid ferrite was found to be very stable when exposed to thermal aging or creep deformation. This stability is explained based on the tendency of molybdenum atoms to form pairs in the ferrite matrix. Nucleation and growth of additional carbide particles during creep testing was not observed. The results of these creep tests and those of Klueh have been interpreted on the basis of Mo pair stability and the affinity between molybdenum and carbon. Fatigue tests at 866°K, however, did produce a fine Mo_2C precipitate which contributed to secondary cyclic hardening in tests lasting longer than 200h. The alloy was found to undergo early cyclic hardening followed by abrupt softening within the first tens of cycles.

36915 On the scavenging effect of precipitated austenite in a low carbon Fe-5.5Ni alloy. Kim, J.I.; Morris, J.W. Jr. (Univ. of California, Berkeley, CA). *Metall. Trans., A;* **11**: No. 8, 1401-1406(Aug 1980).

The scavenging effect of precipated austenite in a low carbon, commercial Fe-5.5Ni cryogenic alloy was investigated through observation of the dissolution of cementite precipitates during intercritical tempering and study of the associated change in Charpy impact toughness. Cementite precipitates initially located along prior austenite grain boundaries were gradually dissolved into reverted austenite as the intercritical tempering proceeded. The austenite tends to form at or around the carbide particles and may be catalyzed by their presence. The Charpy impact energy is changed through both a decrease in the ductile-brittle transition temperature and an increase in the upper shelf energy. The latter effect is specifically associated with the dissolution of the carbides which act as preferential void nucleation sites in the untempered alloy.

36916 Low cycle fatigue behavior of a quenched and tempered niobium bearing HSLA steel. Kwun, S.I. (Korea Univ., Seoul); Fournelle, R.A. *Metall. Trans., A;* **11**: No. 8, 1429-1437(Aug 1980).

The low cycle fatigue behavior of a quenched and tempered niobium (columbium) bearing high strength low alloy steel heat treated to give tempered martensitic microstructures presumably with and without fine niobium carbides was studied by transmission electron microscopy, stress relaxation, X-ray diffraction line broadening and strain-controlled fatigue testing. The steel without the niobium carbides cyclically softened rapidly at all strain amplitudes studied. This softening was attributed to the rearrangement of the dislocation substructure into a cell structure and to the accompanying decrease in internal stress. The steel presumably containing the fine niobium carbides cyclically softened to a lesser extent. This correlated with the observation that dislocations in this steel did not rearrange themselves into a cell structure and, hence, there was less change in the internal stress during cycling. The steel without the niobium carbides exhibited somewhat better strain-life behavior at large strain amplitudes. This was attributed to the cell structure being able to accomodate a greater amount of plastic strain in that steel.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 36048, 36905, 36907, 36936, 36941

36917 Experimental heat capacities of $LaNi_5$, α-$LaNi_5H$/sub 0.36/, and β-$LaNi_5H$/sub 6.39/ from 5 to 300 °K. Thermodynamic properties of the $LaNi_5$—H_2 system. Ohlendorf, D.; Flotow, H.E. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *J. Chem. Phys.;* **73**: No. 6, 2937-2948(15 Sep 1980).

The heat capacities of $LaNi_5$, α-$LaNi_5H$/sub 0.36/, and β-$LaNi_5H$/sub 6.39/ were measured from 5 to 300 °K, and in the case of $LaNi_5$ also from 300 to 350 °K. Various special techniques and unusual circumstances involved in the measurements and calculations are described. A slight enhancement of the heat capacity of β-$LaNi_5H$/sub 6.39/ was observed in the temperature range 120 to 160 °K. The standard entropies of $LaNi_5$, α-$LaNi_5H$/sub 0.36/, and β-$LaNi_5H$/sub 6.39/ at 298.15 °K were found to be 209.9 +- 0.5, 214.1 +- 0.5, and 271.7 +- 0.7 J $°K^{-1}$ $mole^{-1}$, respectively. These results together with other thermochemical data were used to calculate the entropy and enthalpy of formation of β-$LaNi_5H$/sub 6.39/ at 298.15 °K. The partial molar entropy of hydrogen in β-$LaNi_5H$/sub 6.39/ was derived from our results and used to estimate the configurational entropy at 298.15 °K.

36918 Adsorption of CO on Pd(100). Behm, R.J.; Christmann, K.; Ertl, G.; Van Hove, M.A. (Institut fuer Physikalische Chemie, Universitaet Muenchen, Muenchen, West Germany). *J. Chem. Phys.;* **73**: No. 6, 2984-2995(15 Sep 1980).

Adsorption of CO on a Pd(100) surface was studied in detail mainly by LEED, UPS, work function and thermal desorption measurements. Analysis of the ordered c($2\sqrt{2}$ x $\sqrt{2}$) R 45° structure occurring at Θ=0.5 revealed that in this phase each CO molecule is bridge bonded to 2 Pd atoms with Pd—C distances of 1.93 +- 0.07 A and a C—O bond length of 1.15 +- 0.1 A, the molecular axis being oriented normal to the surface. The mutual configuration of the adsorbed molecules is explained in terms of a short-range repulsive interaction model, which is supported by the observation that the isosteric heat of adsorption (E/sub ad/=38.5 kcal/mole) is constant up to a coverage of $\Theta \approx 0.45$. The photoelectron spectra exhibit two maxima at 7.9 ($5\sigma+1\pi$ level) and 10.8 eV (4σ level) below the Fermi level which are in agreement with the observations with other Pd planes. This also holds for an electronic excitation associated with an energy of 13.5 eV as observed by electron energy loss spectroscopy. The variation of the sticking coefficient with coverage is described in terms of a second-order precursor state model with repulsive interactions. The pre-exponential factor for desorption (3 x 10^{16} sec^{-1}) varies only little with coverage. The dipole moment of the adsorbate remains constant up to $\Theta \approx 0.35$ (0.17 D) where the overlayer starts to order, and exhibits an appreciable higher value near Θ=0.5. The maximum work function increase is Δphi/sub max/=0.93 V at Θ=0.5. The differential entropy of the adsorbed layer around 450 K was derived from the experimental adsorption isotherms. Up to Θ=0.35 the data fall well between the limits of two theoretical models for localised and delocalised adsorption of noninteracting particles. Deviations at higher coverages reflect again the onset of ordering. The energetic and work function data are in some variance to results reported earlier.

36919 Thermodynamics and kinetics of interstitial diffusion in a two-component system. McKee, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2649-2657(15 Sep 1980).

Diffusion theory is developed for a two-component system in which only the interstitial element is mobile. A thermodynamic formalism is used in direct parallel with a kinetic theory to construct a mechanism-independent relationship between tracer- and chemical-diffusion coefficients. It is found that D/sup I/=(D-italic*/f)(1+partiallnγ/partiallnC). D/sup I/ is the intrinsic- or chemical-diffusion coefficient for the interstitial, D* is the tracer-diffusion coefficient, f is the correlation factor, and γ is the activity coefficient. This expression accounts for site exclusion, correlation, and drift effects that occur as the interstitial content changes. Generalized phenomenological coefficients that are determined in this analysis can be used for standard representations of diffusion in electric fields and temperature gradients. Moreover, the forms that the phenomenological coefficients take for the interstitial system are the same as those previously derived for vacancy diffusion. A test of this predicted relationship between tracer- and chemical-diffusion coefficients is developed using a comparisor. between theory and experiment for carbon diffusion in fcc iron.

36920 Self-consistent linearized augmented-plane-wave study of the electronic structure and superconductivity of fcc lanthanum under pressure. Pickett, W.E.; Freeman, A.J.; Koelling, D.D. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). W-31-109-ENG-38. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2695-2715(15 Sep 1980).

We report the results of a linearized augmented-plane-wave calculation of the electronic structure of fcc La at three lattice constants corresponding to ambient pressure, 50, and 120 kbars. The Kohn-Sham-Gaspar approximation for exchange and correlation is used and the potential is allowed a fully non-muffin-tin form. The f bands lie ~2—2.5 eV above the Fermi level and are ~1 eV wide, resulting in a very small (0.05 electrons) localized f occupation. Under pressure the f bands rise and broaden appreciably, resulting in only a slight increase in f occupation. The rigid-muffin-tin approximation for the electron-phonon interaction λ overestimates the superconducting transition temperature T/sub c/ by 40%, but we find that the drastic increase in T/sub c/ under pressure can be attributed primarily to changes in the electronic stiffness eta. Structural transitions which occur at 25 and 53 kbars may be related to changes in Fermi-surface topology which we find to occur approximately at these pressures.

36921 Soft-x-ray emission from Li-Al and Li-Mg alloys. Tagle, J.A.; Arakawa, E.T.; Callcott, T.A. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2716-2724(15 Sep 1980).

The K-emission band of Li and L_{23}-emission bands of Mg and Al have been measured for Li-Mg and Li-Al prepared in a range of concentrations by either coevaporation or by evaporating thin films of Li on Mg(Al) substrates or Mg(Al) on Li substrates. The Li K spectrum is nearly unchanged at all alloy concentrations in the Li-Mg system but broadens and develops a low-energy shoulder for large Al concentrations in the Li-Al system. Both Mg and Al L_{23} spectra are narrower and more peaked at low energy in the equilibrium alloys than in the pure metals. The "many-body" threshold peaks on the Al and Mg L_{23} spectra are generally suppressed by alloying with Li, except for low-temperature coevaporated Li-Al samples where the peak persists to very Li-rich alloys. Structure studies of these samples are required before the questions raised by these results can be fully resolved.

36922 Structure of Pd overlayers on Nb and Ta and the relationship to hydrogen uptake. Strongin, M.; El-Batanouny, M.; Pick, M.A. (Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 3126-3129(15 Sep 1980).

Films of Pd deposited onto Nb and Ta undergo a structural change at a thickness of about one monolayer, where the Pd goes from a commensurate structure on (110) Nb and Ta to (111) fcc Pd for thicker films. When this change occurs there is a dramatic increase in the hydrogen-uptake rate into the underlying metal.

36923 Magnetism and superconductivity in C15 compounds from self-consistent band calculations. Jarlborg, T.; Freeman, A.J. (Physics Department, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2332-2342(1 Sep 1980).

All-atom—all-electron self-consistent semirelativistic linear muffin-tin orbital energy-band studies are reported for $TiBe_2$, $ZrZn_2$ (at ambient and high pressures), the high-T/sub c/ superconductor ZrV_2, and the ultralow-T/sub c/ superconductor YAl_2. Total and partial (by atom type and l values) density of states, Stoner-like parameters, electron-phonon coupling parameter λ and superconducting transition temperatures T/sub c/ (determined within the rigid muffin-tin approximation and McMillan's strong coupling theory with and without paramagnon contributions), and their behavior under applied pressure are used to discuss the origin of their observed magnetism and/or superconductivity. From an analysis of the results, we suggest possible high-T/sub c/ superconductivity at high pressure for $ZrZn_2$, and its unlikely occurrence for $TiBe_2$ unless dominant soft phonon modes exist.

36924 Classical cubic model for paramagnetic DySb. Kouvel, J.S.; Brun, T.O. (Department of Physics, University of Illinois, Chicago, Illinois 60680). *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2428-2434(1 Sep 1980).

A classical mean-field model, incorporating quadrupolar and bilinear exchange coupling and a strong but finite cubic crystal field, is developed here for DySb at temperatures above the Neel point. Paramagnetic equations of state are derived in simple form for a small magnetic field applied along various principal crystallographic directions. Quantitative comparisons are made with exact crystal-field calculations and with a recent quantum-mechanical mean-field analysis of quadrupolar exchange in DySb. The classical model gives very reasonable overall agreement and shows explicitly how the two cubic components of the quadrupolar exchange are manifested very differently in the magnetic properties for thermal energies small compared to the crystal-field energy.

36925 Search for Lifshitz points in rare-earth alloys. Legvold, S.; Burgardt, P.; Beaudry, B.J. (Ames Laboratory, U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2573-2578(1 Sep 1980).

Six rare-earth binary-alloy systems have been investigated in a search for Lifshitz points. No such points were found. All systems showed a highest ordering temperature jump when the sample composition went from values favoring helical ordering to values favoring ferromagnetic ordering. It is believed that ferromagnetic nearest-neighbor interactions and antiferromagnetic next-nearest-neighbor interactions are responsible for the observed behavior and that a finite-turn angle jump at the critical concentration will always occur for such systems.

36926 Electronic structure and magnetism of CuNi coherent modulated structures. Jarlborg, T.; Freeman, A.J. (Department of Physics and Astronomy and the Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev. Lett.;* **45**: No. 8, 653-656(25 Aug 1980).

The electronic and magnetic properties of a coherent modulated structure consisting of three atomic layers each of Cu and Ni perpendicular to [111] were determined from ab initio self-consistent spin-polarized energy-band calculations. We predict a susbtantial reduction in spin magnetization and contact hyperfine fields H/sub n/ at the Ni layers (in contrast with enhancements reported earlier from ferromagnetic resonance measurements), charge ($0.1e^-$) and spin ($\sim 0.01\mu$/sub B/) transfer to the Cu sites, and large H/sub n/ at the Cu nuclei.

36927 Static and dynamic magnetic response of the mixed-valence state: Cerium-based alloys. Grier, B.H.; Shapiro, S.M.; Majkrzak, C.F.; Parks, R.D. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). DE-AC02-76CH00016. *Phys. Rev. Lett.;* **45**: No. 8, 666-669(25 Aug 1980).

For the first time crystal-field excitations are observed in the inelastic-neutron-scattering spectra of a mixed-valence system, viz., Ce/sub 0.9-x/La/sub x/Th/sub 0.1/. Scaling relationships are established which connect various energy-related quantities, such as the T=0 Fermi-liquid susceptibility, the valence transition temperature, and the spin-fluctuation energy as measured by the neutron scattering linewidths.

36928 Zero-field spin relaxation of μ^+ as a probe of the spin dynamics of AuFe and CuMn spin-glasses. Uemura, Y.J.; Yamazaki, T.; Hayano, R.S.; Nakai, R.; Huang, C.Y. (Department of Physics, University of Tokyo, Bunkyo-ku, Tokyo, Japan). *Phys. Rev. Lett.;* **45**: No. 7, 583-587(18 Aug 1980).

The zero-field spin relaxation of positive muon is measured in spin-glasses AuFe and CuMn. A stochastic theory of muon spin relaxation in a random dilute spin system is formulated to deduce the correlation time of Fe (or Mn) moments. The observed correlation time increases rapidly from 10^{-10} sec (at $T \sim 1.2T$/sub g/) to 10^{-5} (at $T \sim 0.5T$/sub g/), showing a sharp slowing down of spin fluctuation around T/sub g/.

36929 Spin-wave evolution crossing from the ferromagnetic to spin-glass regime of Fe/sub x/Cr/sub 1-x/. Fincher, C.R. Jr.; Shapiro, S.M.; Palumbo, A.H.; Parks, R.D. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Phys. Rev. Lett.;* **45**: No. 6, 474-477(11 Aug 1980).

Inelastic-neutron-scattering studies on Fe/sub x/Cr/sub 1-x/ for x=0.34 and 0.26 reveal well-defined spin-wave excitations in the ferromagnetic regime and show a significant decrease of the spin-wave stiffness as the temperature is lowered towards the micromagnetic or spin-glass regime. Within the spin-glass phase, no well-defined excitations are seen, but an intense quasielastic peak is observed.

36930 Heat storage in eutectic alloys. Birchenall, C.E. (Univ. of Delaware, Newark, DE); Riechman, A.F. *Metall. Trans., A;* **11**: No. 8, 1415-1420(Aug 1980).

Classical thermodynamic equations based on the regular solution approximation yield enthalpic changes for eutectic transformation that agree roughly with values measured for several binary and ternary alloy systems by differential scanning calorimetry or differential thermal analysis. Restricting measurements to binary and ternary alloys of the relatively plentiful elements Al, Cu, Mg, Si and Zn, it has been verified that the best heat storage densities on a mass or volume basis are obtained with alloys rich in Si or Al, elements that have large heats of fusion. Several of these alloys have the highest heat-storage density reported for phase change materials that transform between 780 and 850°K. The Mg_2Si-Si eutectic, which has outstanding storage density at 1219°K, illustrates the utility of ordered intermetallic phases with large heat of formation that dissolve in the eutectic liquid to contribute to the entropy change.

36931 Trapping of Sb by TiC precipitates in Fe. Myers, S.M.; Follstaedt, D.M.; Rack, H.J. (Sandia National Labs., Albuquerque, NM). *Metall. Trans., A;* **11**: No. 8, 1465-1474(Aug 1980).

Ion-beam experiments have yielded strong evidence for trapping of Sb by TiC precipitates in Fe. Alloyed layers exhibiting this effect were produced by ion implanting Ti, C, and Sb into Fe at room temperature and then aging at 873 or 973 K. The depth distribution of the constituents and the microstructure were monitored by ion backscattering analysis and transmission electron microscopy. Heating initially caused a dense dispersion of TiC precipitates to form, and Sb was bound within the region of the Fe containing these precipitates. No evidence of Sb intermetallic compounds was found. Continued annealing resulted in Sb diffusion from the precipitated layer into the underlying bulk of the Fe, and the kinetics of this release were shown to be consistent with a trapping process. These observations and additional evidence prompt the inference that Sb is bound to the TiC precipitates, presumably occupying the TiC-Fe interface. The binding enthalpy is estimated to be $\sim$ 0.4 eV when referenced to an untrapped Sb site in the α-Fe phase. This trapping effect may provide a means for immobilizing Sb and other metalloid impurities in ferritic steels to inhibit temper embrittlement.

36932 Design of permanent multipole magnets with oriented rare earth cobalt material. Halbach, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Instrum. Methods;* **169**: No. 1, 1-10(Feb 1980).

By taking advantage of both the magnetic strength and the astounding simplicity of the magnetic properties of oriented rare earth cobalt material, new designs have been developed for a number of devices. In this article on multiple magnets, special emphasis is put on quadrupoles because of their frequent use and because the aperture fields achievable (1.2-1.4 T) are rather large. This paper also lays the foundation for future papers on: (a) linear arrays for use as 'plasma buckets' or undulators for the production of synchrotron radiation; (b) structures for the production of solenoidal fields; and (c) three-dimensional structures such as helical undulators or multipoles.

36933 Surface analytic techniques in corrosion science. Larson, D.T. (Rockwell International, Golden, CO). *Corros. Sci.;* **19**: 657-673(1979).

The corrosion scientist now has a selection of several surface sensitive techniques in which commercial instruments and equipment are available to examine and analyze corrosion problems. These techniques include ellipsometry. Auger electron spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA), ion scattering spectrometry (ISS), secondary ion mass spectrometry (SIMS), and electron stimulated desorption (ESD). With these surface techniques, the outer surface monolayers of corrosion products can be examined. Also by utilizing sputter etching, depth profiles of films can be obtained and interfaces analyzed. Passivation layers and effects of thermal and chemical treatments on the surface films can be studied. The basic principles and types of information obtained on various materials using these surface analytical tools are discussed.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 35870, 35871, 35872, 35892, 36136, 36656, 36659, 36933, 37082

36934 (BDX—613-2489) **Comparison of metallization systems for thin film hybrid microcircuits.** Hines, R.A.; Raut, M.K. (Bendix Corp., Kansas City, MO (USA)). Aug 1980. Contract AC04-76DP00613. 44p. NTIS, PC A03/MF A01.

Five metallization systems were evaluated for fabricating thin film hybrid microcircuits. The titanium/palladium/electroplated gold system proved superior in terms of thermocompression bondability, corrosion resistance, and solderability.

36935 (PNL-SA—8178) **Role and efforts of T3C in corrosion economics.** Perrigo, L.D.; Appleman, B.R.; Pamer, R.I.; Thompson, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract AC06-76RL01830. 11p. (CONF-800305—9). NTIS, PC A02/MF A01.

From Corrosion/80 NACE meeting; Chicago, IL, USA (6 Mar 1980).

The basic purpose of T3C activity is to show how to acquire specific corrosion cost information so that overall costs for doing business can be reduced. The scope of T3C is to accumulate data, appraise methods, develop recommended practices, promote knowledge and communicate relative to the economic evaluation of corrosion and counter corrosion techniques.

36936 (SAND—80-2077C) **Surface modification by ion chemical and physical erosion.** Sharp, D.J.; Panitz, J.K.G. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-801037—14). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Physical and chemical ion erosion surface interactions were observed for various elements and composite materials including Si, B, C, TiB_2, WC-Co cermet, and stainless steel samples which have been bombarded by low energy (50 eV-1800 eV) hydrogen ions. The erosion yield characteristics where both chemical erosion and physical erosion can occur, can be compared to the yield characteristics for the same materials bombarded by xenon which results in physical sputtering.

36937 (SAND—80-8033) **Etching and plating of nominal U-6 wt % Nb alloys.** Johnson, H.R.; Dini, J.W.; Wood, D.H. (Sandia National Labs., Albuquerque, NM (USA); California Univ., Livermore (USA). Lawrence Livermore National Lab.). Aug 1980. Contract AC04-76DP00789. 26p. (CONF-801061—1). NTIS, PC A03/MF A01.

From Conference on high density penetration materials; Charlottesville, VA, USA (28 Oct 1980).

The adhesion of electrodeposited nickel to U-Nb alloys is of interest for joining materials by plating and for protection from corrosive environments. Because uranium alloys are passive, a surface preparation procedure such as etching in acid is necessary before plating to provide mechanical keying of the electrodeposit. When nitric acid has served as the etchant, there have been occasional violent reactions between the oxidizing acid and the alloy. We have observed that a sulfuric acid/hydrochloric acid etchant eliminates this problem. Furthermore, quantitative test data for nominal U-6 wt % Nb alloys plated with nickel demonstrated that with parts etched anodically in a solution of sulfuric and hydrochloric acids, high-strength bonds can be obtained; nominal shear and tensile bond strengths were 250 and 115 MN/m^2 respectively. Electrochemically etched U-Nb rods joined to 7075-T6 Al rods with thick nickel plating showed a nominal fracture stress in excess of 470 MN/m^2. Bare and Ni-plated tensile bars showed no significant changes in mechanical properties due to electrochemical etching and plating, but did exhibit changes due to Nb content and heat treatment.

36938 Transformation-induced reduction in the oxidation rate of ordered Zr_3Al. Schulson, E.M. (Dartmouth College, Hanover, NH); Trottier, T.P. *Metall. Trans., A;* **11**: No. 8, 1459-1464(Aug 1980).

Oxidation experiments in air from 775 to 1145°K have established that at temperatures of 975°K and above, the peritectoid $L1_2$ phase, Zr_3Al, under the influence of oxygen and nitrogen, undergoes the reverse peritectoid transformation $Zr_3Al \rightarrow Zr_2Al + Zr$. This decomposition results in the formation of a lamellar Zr_2Al/Zr product beneath the exposed surface. Correspondingly, the shortterm oxidation rate decreases and the oxide film becomes more adherent. The change in character is caused, at least in part, by the preferential oxidation of the αZr phase within the lamellar product, which leads to oxide platelets being held between the unoxidized Zr_2Al lamellae.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 36645, 36647, 37452

36939 (COO—2119-23) **Experiments in high voltage electron microscopy. Progress report, October 31, 1979-July 1980.** Mitchell, T.E.; Hobbs, L.W.; Mukai, T.; Liu, H.; Pascucci, M.; Youngman, R.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Metallurgy and Materials Science). Jul 1980. Contract AS02-76ER02119. 18p. NTIS, PC A02/MF A01.

Radiation effects in alloys and ceramics are reported. There is a variety of effects of irradiation on phase stability in alloys, including radiation-induced and enhanced phase instability, disordering and secondary defect formation in various alloys. In ceramics, the response to irradiation can be even more complex due to considerations of stoichiometry and imbalance in the spectrum of primary defects (anions and cations). These responses are categorized in three ways: (a) the formation of stoichiometric defects (loops and voids), (b) decomposition or precipitation of a second phase, and (c) transition from the crystalline to the amorphous state (amorphization or metamictization).

36940 Direct observation of the trapping of deuterium ions at a grain boundary in tungsten. Kellogg, G.L.; Panitz, J.K.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76DP00789. *Appl. Phys. Lett.;* **37**: No. 7, 625-627(1 Oct 1980).

The imaging atom-probe/field ion microscope has been used to study the trapping of low-energy deuterium ions in tungsten. The experimental results indicate that implanted deuterium does not remain trapped in a tungsten lattice at room temperature for a period of several days unless a defect is present. Time-gated imaging atom-probe images show the first direct correlation between the trapped deuterium and the presence of a grain boundary on an atomic scale. Comparing these results to secondary-ion mass spectrometer and nuclear reaction analyses of simultaneously exposed, flat tungsten, and silicon samples indicates that the imaging atom-probe is sensitive to low levels of hydrogen concentration at lattice defects that are invisible to these other two techniques. The implications of the experiment relating to tokamak plasma-wall and hydrogen embrittlement studies are discussed.

36941 Synergism between strain and neutron irradiation in filamentary Nb_3Sn conductors. Snead, C.L. Jr.; Suenaga, M. (Brookhaven National Laboratory, Upton, New York 11973). *Appl. Phys. Lett.;* **37**: No. 7, 659-661(1 Oct 1980).

The critical temperatures T/sub c/ of Nb_3Sn and $Nb_3(SnGa)$ monofilamentary wires have been measured as a function of neutron fluence to 1.3 x 10^{19} n/cm^2 (E>1 MeV). The bronze overlayer was removed and T/sub c/ remeasured. The differences between the bronze-on and -off conditions, a measure of the "prestrain effect" on the A15 layer, were seen to increase with increasing fluence. This enhancement of the prestrain effect is attributed to buckling of the Nb chains in the vicinity of Sn sites on the Nb chains (antisite disorder), the amount of buckling with the bronze on being greater because of the prestrain. The synergism between irradiation and prestrain is concluded to be a degrading factor in the operation of magnetically confined fusion reactor magnets unless the prestrain (compressive) is completely compensated by the externally applied (tensile) strains.

36942 Dynamics of ion channeling at low energies: Preliminary trajectory studies. Adams, J.E.; Doll, J.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **73**: No. 5, 2137-2144(1 Sep 1980).

In order to understand better recent experiments which have examined the channeling of deuterium ions in tungsten single crystals at low incident energies, we have computed classical trajectories using various sets of ion—atom interaction parameters. Both the penetration depth profiles and the backscattered ion energy spectra display strong dependences upon the particular input parameters but to a much lesser extent upon the level of accuracy to which the individual trajectories are calculated. On the basis of our results we are able to suggest experiments which may resolve present uncertainties about the appropriate description of the microscopic interaction forces.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 36781, 36894, 36895

36943 (DOE/ER/02390—5) **Basic research in crystalline and noncrystalline ceramic systems. Annual report, August 1, 1979-October 31, 1980.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1980. Contract AS02-76ER02390. 101p. NTIS, PC A06/MF A01.

The Basic Research Programs in Ceramics supports a significant fraction of the research effort and graduate student training in ceramics at M.I.T. The importance of basic research programs in ceramics processing and properties is becoming widely recognized as the critical role of improved ceramic materials for energy systems is acknowledged. The needs identified in the 1977 series of workshops on DOE programs in energy-related materials research and by the ongoing efforts of the DOE Council on Materials Science are being translated into the basic and applied research necessary to fulfill the established objectives in the effort to solve the nation's energy problems. Present indications are that ceramics in numerous applications will be critical in meeting national energy requirements.

36944 (DOE/ET/12293—T1) **Mechanical property improvement of protective coatings for turbine engines using coal-derived fuels. Final report.** Beale, H.A. (Battelle Columbus Labs., OH (USA)). 1 Sep 1980. Contract AC03-78ET12293. 21p. NTIS, PC A02/MF A01.

Nb-NbC and Nb-NbB_2 coatings were studied to determine how thermal expansion differences between a metal matrix and a dispersed phase affect the coating properties. Nb-NbC and Nb-NbB_2 coatings were deposited by dual-source electron beam evaporation. Transmission Electron Microscopic (TEM) examination of the deposited coatings revealed that the NbC and NbB_2 in the coating was randomly dispersed with particle sizes of less than 50 A. The effect of such finely dispersed particles on the Peierls stress in the coating was found to have negligible impact on the coating properties.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 36051, 36052, 36053

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 36902, 36903, 36948, 36950

36945 (SAND—80-1030C) **Ion-implanted PLZT ceramics: a new high-sensitivity image storage medium.** Peercy, P.S.; Land, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-801060—1). NTIS, PC A02/MF A01.

From 1980 IEEE-SID biennial display research conference; Cherry Hill, NJ, USA (21 Oct 1980).

Results were presented of our studies of photoferroelectric (PFE) image storage in H- and He-ion implanted PLZT (lead lanthanum zirconate titanate) ceramics which demonstrate that the photosensitivity of PLZT can be significantly increased by ion implantation in the ceramic surface to be exposed to image light. More recently, implantations of Ar and Ar + Ne into the PLZT surface have produced much greater photosensitivity enhancement. For example, the photosensitivity after implantation with 1.5 x 10^{14} 350 keV Ar/cm^2 + 1 x 10^{15} 500 keV Ne/cm^2 is increased by about four orders of magnitude over that of unimplanted PLZT. Measurements indicate that the photosensitivity enhancement in ion-implant-

ed PLZT is controlled by implantation-produced disorder which results in marked decreases in dielectric constant and dark conductivity and changes in photoconductivity of the implanted layer. The effects of Ar- and Ar + Ne-implantation are presented along with a phenomenological model which describes the enhancement in photosensitivity obtained by ion implantation. This model takes into account both light- and implantation-induced changes in conductivity and gives quantitative agreement with the measured changes in the coercive voltage V/sub c/ as a function of near-uv light intensity for both unimplanted and implanted PLZT. The model, used in conjunction with calculations of the profiles of implantation-produced disorder, has provided the information needed for co-implanting ions of different masses, e.g., Ar and Ne, to improve photosensitivity.

36946 Acoustic microscopy techniques for structural ceramics. Kupperman, D.S. (Argonne National Lab., IL); Pahis, L.; Yuhas, D.; McGraw, T.E. *Am. Ceram. Soc. Bull.;* **59**: No. 8, 814-816, 839-841(Aug 1980).

Through-transmission acoustic microscopy techniques employing 100-MHz ultrasonic waves are evaluated for their effectiveness in detecting and characterizing surface and subsurface defects in silicon carbide and silicon nitride components. Destructive examinations as well as radiographic techniques are used to confirm the presence of acoustically indicated defects. The sensitivity of the technique is demonstrated by means of acoustic micrographs of small ($< 100\ \mu m$) artificial and naturally occurring defects. In addition, the microstructure of specimens as revealed by optical techniques is compared with the acoustic micrographs.

36947 Electrical properties of some Y-Si-Al oxynitride glass-ceramics. Leedecke, C.J. (Sandia National Labs., Albuquerque, NM). Contract DE-AC04-76-DP00789. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 479-480(Jul 1980).

The phases developed by heat-treating several Y-Si-Al oxynitride glasses were identified and the electrical properties of the glass ceramics were measured. (FS)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 36952

36948 (LBL—10787) **Toughening of Zirconia composites.** Burlingame, N.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01.

Thesis.

The addition of a ZrO_2 dispersion can significantly enhance the toughness of a ceramic matrix material. The toughness improvement is due to a stress reduction at the tip of a propagating crack which is the result of a preferential martensitic transformation of ZrO_2 particles in the stress field of the crack. From thermodynamic considerations and experimental observations the toughening effect is show to be strongly dependent on the ZrO_2 particle size. The effect of variations in temperature, composition and matrix materials are demonstrated, and analyzed in respect to the resultant deviations in the particle size toughening effect.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 36793, 36796, 36936, 36946, 36947

36949 (SAND—80-0494C) **Measurement of the enthalpy and specific heat of a Be_2C-graphite-UC_2 reactor fuel material to 1980°K.** Roth, E.P. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 28p. (CONF-801102—20). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

The enthalpy and specific heat of a Be_2C-graphite-UC_2 composite nuclear fuel material were measured over the temperature range 300 to 1980°K using differential scanning calorimetry and liquid argon vaporization calorimetry. The fuel material measured was developed at Sandia National Laboratories for use in pulsed test reactors. The material is a hot-pressed composite consisting of 40 vol % Be_2C, 49.5 vol % graphite, 3.5 vol % UC_2 and 7.0 vol % void. The specific heat was measured with the differential scanning calorimeter over the temperature range 300 to 950°K while the enthalpy was measured over the range 1185 to 1980°K with the liquid argon vaporization calorimeter. The normal spectral emittance at a wavelength of 6.5×10^{-5} cm was measured over the experimental temperature range. The combined experimental enthalpy data were fit using a spline routine and differentiated to give the specific heat. Comparison of the measured specific heat of the composite to the specific heat calculated by summing the contributions of the individual components indicates that the specific heat of the Be_2C component differs significantly from literature values and is approximately 0.6 cal/g-K (2.5×10^3 J/Kg-K) for temperatures above 1000°K.

36950 Cesium chromate, Cs_2CrO_4: high-temperature enthalpy increments and other thermodynamic properties. Fredrickson, D.R.; Johnson, G.K.; O'Hare, P.A.G. (Argonne National Lab., IL). *J. Chem. Thermodyn.;* **12**: 801-805(1980).

High-temperature enthalpy increments and derived heat capacities are reported for Cs_2CrO_4. There is a solid-to-solid transition at (1031 +- 3)°K and the melting temperature is (1236 +- 5)°K. The enthalpies of transition and fusion are (2.9 +- 0.6) and (35.3 +- 0.7) kJ mol^{-1}, respectively, and the entropies of transition and fusion are (2.8 +- 0.6) and (28.6 +- 0.5)J K^{-1} mol^{-1}, respectively. Results obtained in this study are combined with other recent data to produce a table of the thermodynamic functions of Cs_2CrO_4 to 1500°K.

36951 Conductance of niobium oxide tunnel barriers. Walmsley, D.G.; Wolf, E.L.; Osmun, J.W. (Ames Lab., IA). *Thin Solid Films;* No. 62, 61-66(1979).

The conductance of plasma-grown oxide barriers on niobium films was measured in Nb-I-Pb tunnel junctions at 4.2°K and model parameters for the barriers were deduced. Prolonged oxidation leads to greater barrier heights. Oxygen vacancies in the barrier and invoked to explain barrier asymmetry.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 36936

36952 Effects of particle size and shape on erosive wear mechanisms. Kosel, T.H.; Turner, A.P.L.; Scattergood, R.O. Argonne, IL; Argonne National Laboratory (1979). 16p.

Scanning and transmission electron microscopy (SEM and TEM) were used to examine mechanisms of erosion of pure fcc metals by angular Al_2O_3 particles and spherical glass microbeads. The depth of the subsurface dislocation damage was found by TEM to be greater for spherical particles than for angular ones. Higher angles of impact produce thicker layers of damage. Erosion with Al_2O_3 particles was observed to result in embedding of Al_2O_3 particle fragments for all angles of impact and velocities. For normal impact the Al_2O_3 particle fragments cover most of the specimen surface, and for certain particle sizes and velocities with entire surface is covered with a composite layer of Al_2O_3 fragments mixed with the specimen metal. Erosion mechanisms under such conditions are discussed. Incubation periods of the true erosion rate (after allowance for embedding effects) are observed for glass microbeads and also for larger Al_2O_3 particles. This is probably due to gradual damage accumulation.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 36939

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 36485

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 36485

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 35965, 36485

DEGRADATION AND EROSION

REFER ALSO TO CITATION(S) 36815

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 36298, 36299, 36302, 36303, 36306, 36308, 36309, 36311, 36486, 36505

36953 (LBL—11392) **Reaction interface in reduction.** Chang, M.; De Jonghe, L.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 10p. (CONF-800765—2). NTIS, PC A02/MF A01.

From 7. LLR/MMRD international symposium of interfaces in glass-metal systems; Berkeley, CA, USA (28 Jul 1980).

When an oxide such as cobalt ferrite is reacted with hydrogen, a porous metal scale will form topochemically from its surface. The pores in the metal scale permit the reducing gas to reach the reaction interface directly. At the pore bottoms the parent oxide is then destroyed by the reduction process, the oxygen is removed in

the form of water vapor, and the cations that are produced at the pore bottoms are transported to the adjacent metal phase. The purpose of the present paper is to clarify the processes occurring at the metal/oxide reaction interface, and to determine which subprocesses are most important in determining the interface reaction rates.

36954 (SAND—80-1763) **Progress report on GaP, grown junction, high temperature diodes.** Chaffin, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01.

This memo discusses current results of an effort to develop GaP (Gallium Phosphide) diodes for high temperature, > 275°C, applications. It discusses the theory, fabrication and testing of devices made at Sandia National Laboratories.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 36902, 36903

36955 Slater-Koster parametrization for Si and the ideal-vacancy calculation. Papaconstantopoulos, D.A.; Economou, E.N. (Naval Research Laboratory, Washington, D.C. 20375). DE-AT-01-79ET-23078. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2903-2907(15 Sep 1980).

A Slater-Koster Hamiltonian for Si is constructed using four (one s and three p) orthogonal orbitals per site. This Hamiltonian reproduces reasonably accurately the empirical pseudopotential band structure not only for the valence but for the conduction band as well. It also determines correctly the position of the bound level of an unreconstructed vacancy demonstrating thus that the effects of electronic self-consistency are minor.

36956 Neutron scattering from coupled phonon-impurity modes in KCl/sub 1-c/(KCN)/sub c/. Nicklow, R.M.; Crummett, W.P.; Mostoller, M.; Wood, R.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 3039-3048(15 Sep 1980).

The hybridization of host-lattice phonons with the internal-energy states of CN^- impurities in KCl has been studied by inelastic neutron scattering as a function of temperature between 10 and 100 K for samples with impurity concentrations in the range c=0.4 to 6 at. %. A temperature- and concentration-dependent coupling between phonons with E/sub g/ symmetry and the E/sub g/ transitions of CN^- ions is observed near a frequency of 0.5 THz, a value which is consistent with the energy-level spacings for CN^- in KCl as deduced by Beyeler. However, an expected coupling of phonons and CN^- transitions with T/sub 2g/ symmetry near the same frequency was not detected. A simple two-level model for the CN^- impurity provides a rather good description of the data for the E/sub g/ coupled modes for c<2 at. %, but it deviates significantly for larger concentrations. Quasielastic scattering, which has a strong dependence on impurity concentration, temperature, and phonon wave vector, is also observed.

36957 Structure of amorphous silicon and silicon hydrides. Postol, T.A.; Falco, C.M.; Kampwirth, R.T.; Schuller, I.K.; Yelon, W.B. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **45**: No. 8, 648-652(25 Aug 1980).

Neutron scattering measurements have been made on pure, hydrogenated, and deuterated samples of amorphous silicon (a-Si) in the wave-vector range 0.007-8,75 A^{-1}. Small-angle data indicate structures in the samples of average radius of gyration as large as 270 A. Large-angle data show that for the concentrations we have measured (14%), the structure of a-Si is not altered by the incorporation of large amounts of H or D. The silicon-hydrogen and silicon-deuterium partial structure factors have also been obtained.

36958 Monte Carlo simulation of Eu^{3+}-doped BeF_2 glass. Brawer, S.A.; Weber, M.J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev. Lett.;* **45**: No. 6, 460-463(11 Aug 1980).

Monte Carlo simulations of the structure of Eu^{3+}-doped BeF_2 glass show that in contrast to the almost perfect fourfold coordination of Be by F, the rare-earth sites are disordered and no fixed coordination number can be defined. The calculated distribution of Eu^{3+} electronic energy levels is in general agreement with the inhomogeneous broadening observed in optical spectra and measured using laser-induced fluorescence line-narrowing techniques.

36959 Sandia scientists improve PLZT with ions. *Am. Ceram. Soc. Bull.;* **59**: No. 8, 868(Aug 1980).

Ion implantation increases photosensitivity and reduces exposure energy required to store photographic images in a transparent lead-lanthanum-zirconate-titanate (PLZT) ceramic device. The image storage device can be used for nonvolatile, but erasable films. H, He, or A ion implantation increases photosensitivity.

PROPERTIES

REFER ALSO TO CITATION(S) 36505, 36549, 36797, 36959

36960 Effect on electrical properties of segregation of implanted P^+ at defect sites in Si. Sadana, D.K.; Strathman, M.; Washburn, J.; Magee, C.W.; Maeenpaeae, M.; Booker, G.R. (Lawrence Berkeley Laboratory, University of California, Berkley, California 94720). *Appl. Phys. Lett.;* **37**: No. 7, 615-618(1 Oct 1980).

The aim of this work was to study the furnace annealing behavior of buried amorphous layers formed due to P^+ implantation into Si and to investigate the effects of annealing on the electrical properties of the implanted layer. For this purpose, P^+ was implanted into (111) Si in a non-channeling direction at 120 KeV to a dose of 3 x $10^{14}/cm^2$ at RT. The implanted samples were subsequently annealed at 750° C. 90° cross-sectional transmission electron microscopy (TEM), MeV He^+ channeling, secondary-ion mass spectrometry (SIMS), and electrical results were obtained from the same specimen. The TEM results showed that the annealing at 750° C resulted in the formation of two discrete damage layers at depths of 600 and 1100A. However, the MeV channeling measurement indicated the presence of three damage regions; the third region being beyond the second damage layer observed by TEM. The SIMS measurements showed pronounced "pileups" of phosphorus atoms at three damage regions. The carrier-concentration profile followed the atomic distribution curve. However, the mobility profile showed decreases only at the two deeper-lying regions.

36961 Effect of a light impurity on the dynamic structure of a monatomic fluid. Postol, T.A.; Pelizzari, C.A. (Solid State Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., A;* **22**: No. 4, 1698-1701(Oct 1980).

We have studied by inelastic coherent thermal-neutron scattering the many-body effects introduced into a fluid by the presence of a light nearly invisible second component. We have observed this effect over a range of wave vectors and frequencies from where the effect is pronounced to where it is no longer experimentally observable.

36962 Hydrostatic-pressure dependence of the ideal-neutral-vacancy levels in GaAs. Osbourn, G.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2898-2902(15 Sep 1980).

A calculation is presented of the hydrostatic-pressure dependence of the ideal-neutral-vacancy levels in GaAs. This model produces triplet anion and cation bound states and a singlet anion bound state. It is found that the pressure derivatives of the triplet states are quite small when measured with respect to the valence-band maximum. This qualitative result does not depend on the position of the triplet-state energy levels in the band gap and is independent of our model parameters. The pressure derivative of the singlet-state level depends on the position of the level in the gap and is model dependent.

36963 Ultraviolet, x-ray-photoelectron, and electron-energy-loss spectroscopy studies of $LaCoO_3$ and oxygen chemisorbed on $LaCoO_3$. Richter, L.; Bader, S.D.; Brodsky, M.B. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 3059-3064(15 Sep 1980).

We report ultraviolet and x-ray-photoelectron spectroscopy and electron-energy-loss spectroscopy results for clean $LaCoO_3$ and $LaCoO_3$ surfaces covered with chemisorbed oxygen at room temperature. Also the temperature dependence of the HeII spectrum ($h\nu$=40.8 eV) for clean $LaCoO_3$ was monitored between ~140 and 1050 K. We found that chemisorbed oxygen caused significant changes in the surface electronic structure of $LaCoO_3$ near the Fermi energy, as did changing temperature. Temperature-dependent electronic properties are expected, based on the known bulk low-spin—high-spin conversion of the trivalent d^6 Co ions, as has been successfully addressed by Goodenough. The temperature dependences we observed, while consistent with Goodenough's bulk model, could also be understood if the ground state of the surface Co ions were reversed from that of the bulk. We suggest that such a reversal could be driven by a small positional relaxation (expansion) of the top atomic layers of the material. Finally we discuss the implications of the chemisorption results and the postulated surface relaxation in light of the Voorhoeve picture of the high catalytic activity of $LaCoO_3$ for CO oxidation.

36964 Photoelectron injection in gases from thin metal films of quartz. Siomos, K.; White, J.; Christophorou, L.G.; Carter, J.G. (Oak Ridge National Lab., TN). *Chem. Phys. Lett.;* **63**: No. 3, 584-590(1 Jun 1979).

Photoelectron injection currents in gases from thin metal films of Pd, Au, and Au + Pd on quartz were measured as a function of film thickness, film homogeneity, gas pressure, pressure-reduced electric field, and photocathode material conditioning. The

relevance of these results of studies of the behavior of excess electrons in fluids (gases and liquids) is indicated.

CORROSION, EROSION, AND DEGRADATION

36965 (SAND—80-0964C) **Corrosion problems in Ti/$KClO_4$ loaded devices when subjected to humid environments.** Massis, T.M.; Healey, J.T.; Huskisson, D.H.; Perkins, W.G. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 17p. (CONF-801048—6). NTIS, PC A02/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

A piston motor/igniter loaded with a Ti/$KClO_4$ pyrotechnic and sealed with a silicone adhesive exhibited serious corrosion problems during aging. Five 24-hour thermal cycles between room temperature and 71°C at 90% relative humidity resulted in extensive surface corrosion of the Kovar pins and severe stress corrosion cracking of the Kovar pins in the vicinity of the bridgewire weld. No corrosion or cracking of the Nichrome bridgewire was observed. Similar results were observed after 60 days at 50% and 90% relative humidity at room temperature. Tests at ambient relative humidity and room temperature caused limited surface corrosion and no observable cracking. It was determined that these problems resulted from the combined presence of chlorine containing contaminants and atmospheric moisture. Chlorine was detected in both the surface corrosion product and the corrosion product in the subsurface cracks. The absence of reaction and/or morphological alteration of the Ti/$KClO_4$ at the pyrotechnic interface with the Kovar indicated the pyrotechnic was not involved in the corrosion reaction, and, hence, the chlorine was present in the surface contamination on the Kovar pins. The aging tests indicate that external moisture was involved in the corrosion reaction. Calculation and experimentation have shown the silicone adhesive used to seal these devices to be permeable to water vapor, and the moisture conditions inside the devices equilibrated with external conditions within a few hours. Corrosion and cracking could be solved by eliminating the source of moisture by hermetically sealing the devices. Tests of hermetically sealed units have confirmed this conclusion.

CHEMISTRY

36966 (BNL—51168) **Program summaries for 1979; energy sciences programs.** (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 87p. NTIS, PC A05/MF A01.

This report describes the objectives of the various research programs being conducted by the Chemical Sciences, Metallurgy and Materials Science, and Process Science divisions of the BNL Dept. of Energy and Environment. Some of the more significant accomplishments during 1979 are also reported along with plans for 1980. Some of the topics under study include porphyrins, combustion, coal utilization, superconductors, semiconductors, coal, conversion, fluidized-bed combustion, polymers, etc. (DLC)

36967 (INIS-mf—5423) **Chemistry and chemical technology. Interinstitute collection of papers.** (Permskij Politekhnicheskij Inst. (USSR)). 1978. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01.

Separate abstracts were prepared for individual papers in scope. (DLC)

36968 (LA—8438-MS) **Compilation of elemental concentration data for NBS Biological and Environmental Standard Reference Materials.** Gladney, E.S. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 124p. NTIS, PC A06/MF A01.

Concentration data on up to 76 elementals in 19 NBS Standard Reference Materials have been collected from 325 journal articles and technical reports. These data are summarized into mean +- one standard deviation values and compared with available data from NBS and other review articles. Data are presented on the analytical procedures employed and all raw data are presented in appendixes.

36969 (LBL—10000, pp 527-543) **Other projects.** Mar 1980. In Materials and Molecular Research Division annual report 1979.

Progress is reported on: solution thermodynamics of sulfites and sulfite oxidation mechanisms, process chemical parameters in aqueous SO_2 removal by lime/limestone scrubbers, coal liquefaction research, thermodynamic properties of chemical species in nuclear waste, high strength austenitic alloys for generator retaining rings, oxygen reduction in concentrated phosphoric acid by carbon-supported Pt alloy electrocatalysts, and substructure and properties of sodium beta alumina solid electrolytes. (DLC)

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 36892

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 35902, 35903, 36019, 36020, 36021, 36022, 36024, 36029, 36030, 36031, 36032, 36033, 36034, 36174

36970 **Correction for variable moderation and multiplication effects associated with thermal neutron coincidence counting.** Baron, N. (Los Alamos Scientific Lab., NM (USA)). pp 161-177 of Nuclear safeguards technology, 1978. Vol. 2. Vienna; IAEA (1979).

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

A correction is described for multiplication and moderation when doing passive thermal-neutron coincidence counting non-destructive assay measurements on powder samples of PuO_2 mixed arbitrarily with MgO, SiO_2, and moderating material. The multiplication correction expression is shown to be approximately separable into the product of two independent terms: F/sub Pu/, which depends on the mass of ^{240}Pu, and F/sub αn/, which depends on properties of the matrix material. Necessary assumptions for separability are (1) isotopic abundances are constant, and (2) fission cross-sections are independent of incident neutron energy: both are reasonable for the 8% ^{240}Pu powder samples considered here. Furthermore, since all prompt fission neutrons are expected to have nearly the same energy distributions, variations among different samples can be due only to the moderating properties of the samples. Relative energy distributions are provided by a thermal-neutron well counter having two concentric rings of ^{3}He proportional counters placed symmetrically about the well. Measured outer-to-inner ring ratios raised to an empirically determined power for coincidences, (N/sup .I//N/sup .O//sup Z/, and singles, (T/sup .O//T/sup .I// sup delta/ provide corrections for moderation and F/sub αn/, respectively, and F/sub Pu/ is approximated by M/sup X_{240}/sup XI//M_{240}. The exponents are calibration constants determined by a least-squares fitting procedure using standards data. System calibration is greatly simplified through use of the separability principle. Once appropriate models are established for F/sub Pu/ and Fsub(αn), only a few standards are necessary to determine the calibration constants associated with these terms. Since F/sub Pu/ is expressed as a function of M_{240}, correction for multiplication in a subsequent assay demands only a measurement of F/sub αn/.

36971 (DOE/ER/05173—12) **Non-destructive determination of trace-element concentrations. Annual progress report.** Gordon, G.E.; Zoller, W.H.; Walters, W.B. (Maryland Univ., College Park (USA). Dept. of Chemistry). Aug 1980. Contract AS05-76ER05173. 42p. NTIS, PC A03/MF A01.

In this year's Report, the neutron-capture prompt γ-ray activation analysis (PGAA) for trace-element concentrations was used in several new types of samples such as: volcanic samples which included yellow deposits found near volcanoes, fresh ash samples, and suspended particles in plumes from Mt. St. Helens with aircraft; energy related samples which were coal, coal fly ash, oil shale, shale oil and oil; biological samples of freeze-dried blood and liver; neutron-capture cross-sections of borehole samples; and boron in semiconductor silicon. The report includes recommended γ-ray lines for quantitative determinations, systems improvements of the beam filter system, second sample position and data handling facilities.

36972 (GJBX—158(80)) **Uranium/thorium determinations on samples collected from seven quadrangles in eastern Alaska.** Tysdal, A.K. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1980. Contract AC13-76GJ01664. 91p. NTIS, PC A05/MF A01.

Uranium and thorium determinations for 1,314 rock and sediment samples collected from seven quadrangles located in eastern Alaska are presented. Uranium was detected by fluorometry on 1049 samples and by delayed neutron counting on 265 samples; thorium was detected by spectrophotometry and by x-ray fluorescence, respectively.

36973 **Modern methods for trace element analysis.** Pinta, M. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978). 503p.

Translated from French.

Various analytical methods for the determination of trace elements are discussed with particular emphasis on determination of trace elements in the environment. The methods covered in detail are fluorometry, emission spectroscopy, flame atomic absorption spectrometry, flameless atomic fluorescence spectrometry, x-ray fluorescence spectrometry, and activation analysis. Much additional information is included in the appendices. (BLM)

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 36896, 37036, 37180

36974 Potentiometric microdetermination of 1,3,5-trinitro-1,2,5-triazacyclohexane and 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane in several solvents. Selig, W. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Microchem. J.;* **24**: 73-79(1979).

Pyridine, tetramethyl guanidine, and hexamethylphosphoramide were evaluated as solvents for the microdetermination of two weakly acidic compounds of ordnance interest, 1,3,5-trinitro-1,3,5-triazacyclohexane and 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane. The titrant was tetrabutylammonium hydroxide in methanol/toluene. Endpoints were determined potentiometrically by a glass/modified calomel electrode system or by two polarized platinum electrodes. The largest endpoint break was found in the very basic solvent tetramethylguanidine. Endpoint detection using two polarized platinum electrodes significantly enhanced the precision of the anaysis. 4 figures, 2 tables.

36975 Fulvic acid interferences on ATP determinations in sediments. Cunningham, H.W.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). *Limnol. Oceanogr.;* **23**: No. 1, 166-173(Jan 1978).

Organic and cationic inhibitions of ATP determination in sedimentary systems are large. Cationic inhibitions are reversible and can be successfully removed by cation exchange resins or by precipitation with oxalic acid. Acid-soluble organic compounds (fulvic acids) complex with extracted ATP; 70 to 80% of the ATP will not react with the luciferin-luciferase complex. Inhibitions by the fulvic acid are not reversible. When combined with other metabolic parameters. ATP concentrations provide a good estimate of the metabolic activity of a community. 3 figures, 6 tables.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 36024, 36030, 36031, 36032, 36033, 36034, 36972, 36973

36976 Instrumental interferences in x-ray fluorescence analysis of thin samples. Bonner, N.A. (Univ. of California, Livermore). Contract W-7405-ENG-48. *X-Ray Spectrom.;* **8**: No. 1, 30-32(1979).

A method is described for correcting x-ray fluorescence spectra for the presence of instrumental interference peaks. The method applies particularly to the analysis of samples which are not infinitely thick. The intensities of coherently and incoherently scattered exciter radiation are used to determine the variable intensity of the interference peaks.

36977 (K/ET—5009) **Application of nuclear measurement techniques to pilot plant analysis.** Stephenson, M.J.; Little, D.K.; Schultz, R.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1980. Contract W-7405-ENG-26. 43p. (CONF-801104—3). NTIS, PC A03/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

Nuclear spectroscopy has been successfully employed to monitor the operation and performance of a number of different pilot plant and production scale mass transfer systems. Unparalleled insights were gained in a few cases that would have been nearly impossible using conventional procedures. An external gamma scanning device is described that was used to obtain direct measurement of packed column, cold trap, and fixed bed concentration/loading profiles. A number of these operating scans are presented to demonstrate the analytical capability and general utility of the method. Current interest is being directed toward the development of a gamma spectroscopy-based process control system.

36978 (SAND—80-1309) **Description of CORSET: a computer program for quantitative x-ray fluorescence analysis.** Stohl, F.V. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 92p. NTIS, PC A05/MF A01.

Quantitative x-ray fluorescence analysis requires a method of correcting for absorption and secondary fluorescence effects due to the sample matrix. The computer program CORSET carries out these corrections without requiring a knowledge of the spectral distribution of the x-ray source, and only requires one standard per element or one standard containing all the elements. Sandia's version of CORSET has been divided into three separate programs to fit Sandia's specific requirements for on-line analysis in a melt facility. The melt facility is used to fabricate new alloys with very variable compositions and requires very rapid analyses during a run. Therefore, the standards must be analyzed several days in advance. Program DAT1 is used to set up a permanent file consisting of all the data related to the standards. Program UNINT is used to set up a permanent file with the intensities, background counts and counting times of the unknowns. Program CORSET uses the files created in UNINT and DAT1 to carry out the analysis. This report contains descriptions, listings, and sample runs for these programs. The accuracy of the analyses carried out with these three programs is about 1 to 2% relative with an elemental concentration of about 10 wt %.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 36007, 36019, 36020, 36021, 36022, 36024, 36029, 36030, 36031, 36032, 36033, 36034, 36040, 36963, 36972, 36973, 37002, 37011, 37035, 37238

36979 (RFP-Trans—288) **Spectral method for determination of impurities in vanadium pentoxide.** Poliakov, P.M.; Rusanov, A.K. Translated from *Fizicheskie Metody Issledovaniia;* No. 9, 1070-1075(1955). 8p. NTIS, PC A02/MF A01.

In this report it is shown that quantitative and qualitative analysis of impurities in vanadium pentoxide can be successfully achieved with proper selection of conditions for specimen vaporization and excitation of atoms. Spectrographs with moderate dispersion, e.g., the quartz ISP-22 and the glass ISP-51 with a focal length of 270 mm are suitable for this purpose. Procedures for determining aluminum, iron, magnesium, manganese, silicon, copper, antimony, lead, bismuth, arsenic, cadmium, zinc, and phosphorus are given.

36980 Harmonic saturated spectroscopy for improved atomic detection. Frueholz, R.P.; Gelbwachs, J.A. (Aerospace Corporation, Chemistry A Physics Laboratory, P.O. Box 92957, Los Angeles, California 90009). *Appl. Opt.;* **19**: No. 16, 2735-2741(15 Aug 1980).

A novel method for improved cw laser-induced atomic fluoresence detection that we call harmonic saturated spectroscopy takes advantages of the nonlinear response of an optically saturated atomic system to reject background sources of interference. A reduction in background and an improved SNR are demonstrated for sodium detection in an air—acetylene flame. The dependence of the harmonic signal on intensity, excitation waveform, and depth of modulation was also investigated.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 37030

36981 (CONF-800814—20(Draft)) **Application of pressurized ion exchange to separations of transplutonium elements.** Campbell, D.O. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

High-pressure ion exchange chromatography, used first for nucleic acid separations, was applied to the production of the heavier actinides, particularly the transcurium elements. Its use at the TRU plant is described. Future developments are considered briefly. (DLC)

36982 (DOE/ER/00854—28) **Liquid chromatographic fractionations of mixtures of polystyrene oligomers.** Curtis, M.A.; Webb, J.W.; Warren, D.C.; Brandt, V.O.; Gerberich, F.G.; Raut, K.B.; Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 24 May 1980. Contract AS09-76ER00854. 35p. NTIS, PC A03/MF A01.

Oligomer mixtures of 800, 2200, and 4000 molecular weight polystyrene have been fractionated using silica and bonded phase columns under similar conditions of solvent gradient and flow rate. Using a hexane/tetrahydrofuran gradient, the silica and nitro phases were best in that they separated 41 and 43 oligomers, respectively. At the other extreme, a phenyl bonded phase column gave virtually no resolution using a water/THF gradient and a cyano bonded phase column, using the earlier hexane/tetrahydrofuran system, resolved only 10 oligomers. Amino and octadecyl bonded phase columns gave results intermediate between these two extremes. The strength of the solvent used to dissolve the sample was found to be of critical importance. Use of too good a sample solvent seriously degraded the attainable resolution. When number average and weight average molecular weights for an 800 molecular weight polystyrene sample were calculated from the oligomer distribution, the silica column gave values which were most consistent with those reported from other methods.

36983 (DOE/ER/00854—30) **Multi-temperature gas chromatography using isothermal columns in series. Technical report .** Spencer, W.A.; Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 11 Aug 1980. Contract AS09-76ER00854. 38p. NTIS, PC A03/MF A01.

A computer-controlled three-oven gas chromatograph having a multi-position stream-switching valve has been used first to divide a wide-boiling mixture of n-alkanes into three cuts and then to fractionate each cut using a packed column at a different temperature. After initial injection of the sample into the highest temperature column, the low boilers were switched to a low temperature oven. Then, the mid-boilers were switched to a column at an intermediate temperature. For routine repetitive analyses, the multi-oven approach offers an attractive alternative.

36984 (DOE/ER/00854—31) **Fundamental studies of separation processes. Technical progress report, 15 August 1979-14 August 1980.** Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 1980. Contract AS09-76ER00854. 18p. NTIS, PC A02/MF A01.

During the past year, four technical reports have been issued. These have dealt with relative retentions in gas chromatography of the sulfur isotopes in COS, CS_2 and SO_2, fractionations of oligomers in commercial polystyrene, identifications of classes of compounds removed from different types of carbonaceous materials by supercritical pentane, and a comparison of the speed of a system of multiple isothermal columns with that of a programmed-temperature column for the fractionation of a mixture of compounds covering a wide range of boiling points. Other studies have involved optimization of the recycle mode in gas chromatography, selective weighting of peaks in the measurement of information conveyed by a chromatogram, development of procedures for the isolations of various vanadium compounds from Venezuelan crude oil, and evaluation of the effect of organic ligand on the sensitivity of the flame emission signal observed for vanadium.

36985 Identification of fluorescent derivatives of adenosylmethionine and related analogues with high-pressure liquid chromatography. Shugart, L. (Oak Ridge National Lab., TN). *J. Chromatogr.;* **174**: 250-253(1979).

This paper describes a facile method in which high-pressure liquid chromatography is used for the separation, identification, and quantitation of fluorescent derivatives of adenosylmethionine and several analogues; its applicability for measurement of enzyme activities is also demonstrated. 1 table.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 35892, 36167, 36918

36986 (LBL—10000, pp 206-249) **Materials sciences: materials chemistry.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Research is reported on chemical structure (low temperature properties of materials, electrochemical processes) and high-temperature and surface chemistry (film deposition, electrochemical phase boundaries, solid-state and surface reactions, NMR). (DLC)

36987 (LBL—10000, pp 253-377) **Chemical sciences: fundamental interactions.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Progress is reported of research on photochemistry, chemical physics (molecules on surfaces, molecular beam spectroscopy, collisions, photoelectron spectroscopy, crossed molecular beams), and atomic physics. (DLC)

36988 (LBL—10000, pp 378-427) **Chemical sciences: processes and techniques.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Studied were: formation and dimerization of bisulfite ion, conversion of coal to clean liquid and gaseous fuels, synthetic and physical chemistry, electrochemical systems, metal cluster-metal surface analogy, high-energy oxidizers and localized-electron solids, catalyzed conversion of CO, NO, H_2 and organic molecules to fuels and petrochemicals, and high-pressure phase equilibria in hydrocarbon-water (brine) systems. (DLC)

36989 (LBL—10634) **Problem of long-range forces in the computer simulation of condensed media.** Ceperely, D. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 74p. (CONF-800127—). NTIS, PC A04/MF A01.

From Problem of long range forces in the computer simulation of condensed media conference; Menlo Park, CA, USA (8 Jan 1980).

Simulation (both Monte Carlo and molecular dynamical) has become a powerful tool in the study of classical systems of particles interacting with short-range pair potentials. For systems involving long-range forces (e.g., Coulombic, dipolar, hydrodynamic) it is a different story. Relating infinite-system properties to the results of computer simulation involving relatively small numbers of particles, periodically replicated, raises difficult and challenging problems. The purpose of the workshop was to bring together a group of scientists, all of whom share a strong direct interest in clearly formulating and resolving these problems. There were 46 participants, most of whom have been actively engaged in simulations of Hamiltonian models of condensed media. A few participants were scientists who are not primarily concerned, themselves, with simulation, but who are deeply involved in the theory of such models.

36990 Reaction path Hamiltonian: Tunneling effects in the unimolecular isomerization HNC→HCN. Gray, S.K.; Miller, W.H.; Yamaguchi, Y.; Schaefer, H.F. III. (Department of Chemistry, and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 6, 2733-2750(15 Sep 1980).

The reaction path Hamiltonian model recently formulated by Miller, Handy, and Adams [J. Chem. Phys. 72, 99 (1980)] is applied to the unimolecular isomerization HNC→HCN. The reaction path, and the energy and force constant matrix along it, are calculated at the SCF level with a large basis set ("double zeta plus polarization"), and the microcanonical rate constant k(E) is computed in the energy range near and below the classical threshold of the reaction. It is seen, for example, that rates as fast as 10^8 sec^{-1} can occur at energies ~8 kcal/mole below the classical threshold.

36991 Properties of clusters in the gas phase: V. Complexes of neutral molecules onto negative ions. Keesee, R.G.; Lee, N.; Castleman, A.W. Jr. (Department of Chemistry and Chemical Physics Laboratory, CIRES, University of Colorado, Boulder, Colorado 80309). *J. Chem. Phys.;* **73**: No. 5, 2195-2202(1 Sep 1980).

Ion—molecules association reactions of the form A⁻ (B)/sub n1/-+B=A⁻ (B)/sub n/ were studied over a range of temperatures in the gas phase using high pressure mass spectrometry. Enthalpy and entropy changes were determined for the stepwise clustering reactions of (1) sulfur dioxide onto Cl^-, I^-, and NO_2^- with n ranging from one to three or four, and onto SO_2^- and SO_3^- with n equal to one; and (2) carbon dioxide onto Cl^-, I^-, NO_2^-, CO_3^-, and SO_3^- with n equal to one. From these data and earlier hydration results, the order of the magnitude of the enthalpy changes on the association of the first neutral for a series of negative ions was found to parallel the gas-phase basicity of those anions. For any given ion, the relative order of the addition enthalpies among the neutrals was found to be dependent on the polarizabilities of the neutrals and on the covalency in the ion-neutral bond. Dispersion of charge via covalent bonding was found to affect significantly the succeeding clustering steps.

36992 Reaction of tetranuclear mixed-metal clusters with carbon monoxide. Fox, J.R.; Gladfelter, W.L.; Geoffroy, G.L. (Pennsylvania State Univ., University Park). *Inorg. Chem.;* **19**: No. 9, 2574-2578(Sep 1980).

Reaction of the mixed-metal tetranuclear clusters $H_2FeRu_3(CO)_{13}$, $H_2FeRu_2Os(CO)_{13}$, $H_2FeRuOs_2(CO)_{13}$, $HCoRu_3(CO)_{13}$, $H_2FeRu_3(CO)_{12}L$ (L = PMe_2Ph, PPh_3), $[HFeRu_3(CO)_{13}]^-$, and $[CoRu_3(CO)_{13}]^-$ with CO under relatively mild conditions (P(CO) = 1 atm, t = 0-80°C) results in their fragmentation to give trimeric and monomeric products. The fragmentation reactions are generally quite selective: $H_2FeRu_2Os(CO)_{13}$, for example, reacts with CO to give $Ru_2Os(CO)_{12}$, $Fe(CO)_5$, and H_2 with no $RuOs_2(CO)_{12}$, $FeRu_2(CO)_{12}$, or $FeRuOs(CO)_{12}$ detected in the product mixture. This reaction and the corresponding fragmentation of $H_2FeRuOs_2(CO)_{13}$ provide a convenient means of separating and isolating the mixed-metal trimers $Ru_2Os(CO)_{12}$ and $RuOs_2(CO)_{12}$. The reactivity of a particular cluster toward CO is greatly dependent on its metal composition and/or its structure. For example, $H_2FeRu_2Os(CO)_{13}$ reacts slowly over a period of several days while the breakdown of $HCoRu_3(CO)_{13}$ is complete within 1h. The tetrahydride clusters $H_4FeRu_3(CO)_{12}$ and $H_4Ru_4(CO)_{12}$ first react with CO to displace H_2 and form the corresponding dihydride clusters which subsequently fragment under the reaction conditions. Kinetic measurements indicate that the fragmentation of $H_2FeRu_3(CO)_{13}$ to produce$Ru_3(CO)_{12}$, $Fe(CO)_5$, and H_2 proceeds largely by a second-order, [CO]-dependent path with activation parameters ΔH° not equal to = 20.0 +- 2.0 kcal/mol and ΔS° not equal to = -25.4 +- 5.8 cal/(mol K). Likewise, fragmentation of $H_2Ru_4(CO)_{13}$ to form $Ru_3(CO)_{12}$, $Ru(CO)_5$, and H_2 proceeds via a second-order, [CO]-dependent path with ΔH° not equal to = 12.5 +- 0.5 kcal/mol and ΔS° not equal to = -36.6 +- 1.6 cal/(mol K).

36993 Crystal and molecular structure of bis[dicarbonyl(π-pentamethylcyclopentadienyl)iron], (eta⁵-C_5Me_5)$_2Fe_2(CO)_4$, and structural comparisons with the nonmethylated analogue. Teller, R.G.; Williams, J.M. (Argonne National Lab., IL). *Inorg. Chem.;* **19**: No. 9, 2770-2773(Sep 1980).

The molecular structure of (eta⁵-C_5Me_5)$_2Fe_2(CO)_4$ has been determined via x-ray diffraction. The dimer has a monoclinic unit cell of space group $P2_1/n$ with a = 8.372 (4) A, b = 9.864 (5) A, c = 13.872 (5) A, β = 93.13 (1)°, V = 1144 (1) A³, d/sub calcd/ = 1.43 g/cm³, d/sub obsd/ = 1.46 g/cm³, and Z = 2. The molecule contains two terminal and two bridging carbonyl ligands with a normal Fe-Fe single bond separation of 2.560 (1) A. The most unusual finding in this study is that, unlike the case for the unsubstituted analogue (eta⁵-C_5H_5)$_2Fe_2(CO)_4$, no significant variations in the cyclopentadienyl ligand C-C bond lengths are observed. This result

may bear directly on the catalytic activity, or lack of it, observed in certain permethylated-cyclopentadienyl complexes.

36994 Theoretical studies on the physical properties and bonding of the 5d metal hexafluorides using the multiple scattering Xα technique. Bloor, J.E.; Sherrod, R.E. (Univ. of Tennessee, Knoxville). *J. Am. Chem. Soc.;* **102**: No. 13, 4333-4340(18 Jun 1980).

Nonrelativistic overlapping spheres Xα multiple scattering OSMSXα calculations have been performed on the 5d heavy metal hexafluorides MF_6, where M = W, Re, Os, Ir, Pt, and Au, and on MoF_6 and SF_6. With the aid of these calculations a consistent interpretation of the ionization potentials (IPs), electron affinities (EAs), and charge transfer (CT) electronic absorption bands for these molecules is obtained. The calculations are also shown to be successful in interpreting molecular properties related to the charge-density distributions. The method is found to be very useful in predicting trends in all the properties across the 5d series. Relativistic effects are discussed, and for the EAs it is found necessary to take into account these effects. After a semiempirical correction factor of ~ 1.0 eV, deduced from the molecular spin-orbit coupling constants is applied, the EAs are found to agree well with the most recent experimental estimates.

36995 Fischer-Tropsch chemistry: structure of a seminal eta²-CH cluster derivative, $HFe_4(eta^2\text{-}CH)(CO)_{12}$. Beno, M.A. (Argonne National Lab., IL); Williams, J.M.; Tachikawa, M.; Muetterties, E.L. *J. Am. Chem. Soc.;* **103**: No. 13, 4542-4544(18 Jun 1980).

Results of x-ray crystallographic studies of the complex $HFe_4(eta^2\text{-}CH)(CO)_{12}$ are reported. The complex may provide information that relates to intermediates in some metal-surface catalyzed Fischer-Tropsch reactions. The complex was found to contain a butterfly arra$_y$ of four Fe atoms, each with three terminal carbonyl ligands, with the carbidic C atom nestled near the center of the top of the wings of the Fe_4 array where it forms a strong C-H-Fe interaction. Measurements of the bond distances are given. (BLM)

36996 Synthesis of covalently linked dimeric derivatives of chlorophyll a, pyrochlorophyll a, chlorophyll b, and bacteriochlorophyll a. Wasielewski, M.R.; Svec, W.A. (Argonne National Lab., IL). *J. Org. Chem.;* **45**: No. 10, 1969-1974(9 May 1980).

Bis(chlorophyllide) ethylene glycol diesters were prepared for each of the title compounds. Pheophytins a and b isolated from alfalfa and bacteriochlorophyll a isolated from R. sphaeroides were treated with 80% aqueous trifluoroacetic acid to yield the corresponding pheophorbides. Pyropheophorbide was prepared by a literature procedure. Carbonic anhydride and benzotriazole-1-methanesulfonate activation methods were used in the esterification of the pheophorbides with ethylene glycol at ambient temperature. Each method yielded 75% + of the pheophorbide ethylene glycol monoester. These monoesters were treated with equimolar amounts of the corresponding pheophorbide by using benzotriazol-1-methanesulfonate/4-(dimethylamino)pyridine in CH_3Cl_2 or dicyclohexylcarbodiimide/4-(dimethylamino)pyridine in CH_2Cl_2 at ambient temperature. Yields of bis(phenophorbide) ethylene glycol diesters averaged about 50% for the former method and 70% for the latter method. Insertion of the magnesium atoms into the a series macrocycles was accomplished with iodomagnesium 2,6-di-tert-butyl-4-methylphenolate, IMgBHT, in CH_2Cl_2, while the metalation of the b and bacterial series macrocycles was carried out with a mixture of IMgBHT and lithium 2,2,6,6-tetramethylpiperidide in thiophen, all at ambient temperature. Both mono- and dimetalated derivatives were isolated and characterized in each case.

36997 Production of dixenon cation by reversible oxidation of xenon. Stein, L.; Henderson, W.W. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **102**: No. 8, 2856-2857(9 Apr 1980).

Xe_2^+ was produced as a bright green paramagnetic ion in the reduction of xenon(II) in antimony pentafluoride. The ion was characterized by its Raman, uv-visible, and ESR spectra. Monitoring the 287 nm band of XeF^+ and the 335 nm band of Xe_2^+ showed evidence that the reaction of $XeF^+Sb_2F_{11}^-$ with xenon gas at ambient temperature and pressure up to 500 Torr was completely reversible many times. (BLM)

36998 Preparation of a stabilized formyl complex from carbon monoxide and hydrogen and the crystal structure of a derivative in which the C-O bond has been cleaved. Belmonte, P. (Massachusetts Inst. of Tech., Cambridge); Schrock, R.R.; Churchill, M.R.; Youngs, W.J. Contract ER-78-S-02-4949. *J. Am. Chem. Soc.;* **102**: No. 8, 2858-2860(9 Apr 1980).

A stabilized formyl complex, a dimeric tantalum hydrido formyl complex, was prepared by reacting a dimeric tantalum hydride complex with CO. Results of spectral studies of various intermediate compounds and the stabilized complex are reported. The complex $Ta_2(eta^5\text{-}C_5Me_4R)_2Cl_5H$ (1) was found to react with 1 mole of CO to yield an analogous stabilized formyl complex with a Cl in place of the terminal H. This complex was not characterized due to its poor solubility properties. No reaction of 1 with H_2 or CO under mild conditions was noted; however, 1 was found to react with PMe_3 to yield a crystalline dimer with the formula.

36999 Excess enthalpies of binary liquid mixtures: (1 - x)AgCl + $xCdCl_2$, + $xMnCl_2$, + $xFeCl_2$, and + $xCoCl_2$. Papatheodorou, G.N. (Argonne National Lab., IL); Kleppa, O.J. Contract W-31-109-ENG-38. *J. Chem. Thermodyn.;* **12**: 807-809(1980).

The single-unit high-temperature reaction calorimeter was used to determine the excess enthalpies of the following fused-salt mixtures: (1-x)AgCl + $xCdCl_2$, + $xMnCl_2$, + $xFeCl_2$, and + $xCoCl_2$. A table is presented listing the measured excess enthalpies, total amount of substances used, the mole fraction of MCl_3, and the temperature of the mixture. A graph is also presented where the interaction parameter, λ = H/sup E/x(1-x) is plotted against mole fraction.

37000 Softening of transverse elastic modes at the structural phase transition of s-triazine, $C_3N_3H_3$. Heilman, I.U.; Ellenson, W.D.; Eckert, J. (Brookhaven National Lab., Upton, NY). *J. Phys., C (London);* **12**: L185-L189(1979).

The molecular crystal s-triazine, $C_3N_3H_3$, is known to undergo a transition from a trigonal to a monoclinic structure when cooled below T/sub c/ = 200°K. Inelastic neutron scattering measurements have been carried out on a single crystal of s-triazine at various temperatures. A pronounced softening of transverse modes governed by the elastic constant c_{44} is observed in the vicinity of T/sub c/. The phonon response remains underdamped at energies down to at least 0.07 meV and no central peak is observed. The transition seems to be slightly first order (quasi-continuous) in accordance with recent observations, while it has been reported to be of second order at higher pressures. 3 figures.

37001 5s-5p elements beyond tin: (Sb, Te, I, Xe). Ruby, S.L.; Shenoy, G.K. (Argonne National Lab., IL). pp 617-659 of Moessbauer isomer shifts. Amsterdam, Netherlands; North-Holland Publishing Company (1978).

In the sequence of elements, tin through xenon, each possesses a convenient Moessbauer resonance level; their nuclear properties are sufficiently sensitive so that hyperfine measurements give information on the electronic structure of systems investigated. This chapter is devoted to a systematic discussion of isomer shifts for antimony, tellurium, iodine, and xenon systems. Included in the discussion are the effect of oxidation states or ionicity, bond character, relation to quadrupole coupling, electron densities, isoelectronic pairs of compounds, correlation between electron density and isomer shift. 51 references, 12 figures, 16 tables.

37002 Diode laser measurements of NH_3 absorption lines around 10.6 μm. Nereson, N. (Los Alamos Scientific Lab., NM). *J. Mol. Spectrosc.;* **69**: 489-493(1978).

Carbon dioxide emission lines were used as a standard for determining accurate line positions for ammonia. The wave numbers of the NH_3 absorption lines measured in the present study are tabulated. The improved accuracy should lead to improved molecular constants for ammonia. The experimental arrangement is described. 3 figures, 1 table.

37003 (SAND—80-6020) **Thermochemistry of the aluminothermic process.** Pliner, Y.L. Translated from *Sb. Tr. Chelyabinsk. Elektrometall. Komb.;* No. 2, 99-103(1970). 10p. NTIS, PC A02/MF A01.

This paper examines the possibility of establishing a correlation between the heat of reaction by Al with various metal oxides and the temperature of the reaction products. Complete and incomplete reduction and thermal losses are considered. (DLC)

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 36984

37004 Variational transition state theory. Primary kinetic isotope effects for atom transfer reactions. Garrett, B.C.; Truhlar, D.G. (Univ. of Minnesota, Minneapolis). Contract DE-AC02-79ER10425. *J. Am. Chem. Soc.;* **102**: No. 8, 2559-2570(9 Apr 1980).

The effect of variational determination of the location of the generalized transition state on the prediction of kinetic isotope effects for atom transfer reactions is considered. Instead of choosing the transition state dividing surface on the basis of the conventional maximum energy criterion, a maximum free energy criterion in which entropic effects compete with energetic effects is used. Several reactions with symmetric and nearly symmetric saddle points, loose saddle points, and intermediate cases are considered. Numerical examples are based on model potential energy surfaces for three-body systems. The model potential energy surfaces are based on a modified and extended bond-energy, bond-order method that have been presented previously. Examples involving isotopic substitution by ^2H, ^3H, ^{14}C, and ^{37}Cl for a wide range of temperatures are presented. In some cases the results of the variational calculations essentially confirm the more readily used conventional transition state theory. However, this is not always the case. It is shown that

the location of the variationally best transition state dividing surface is sometimes very sensitive to isotopic substitution. Furthermore, this sometimes leads to a large change in the predicted kinetic isotope effect.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 36984

37005 (MLM—2756) **Mound Facility activities in chemical and physical research: January-June 1980.** (Mound Facility, Miamisburg, OH (USA)). 29 Aug 1980. Contract AC04-76DP00053. 56p. NTIS, PC A04/MF A01.

I. Low temperature research covered Hydrogen Intermolecular Potential Functions: five potentials have been compared to bound state energies, second virial coefficients, and total and differential scattering cross sections, but none of them consistently fits all of the data. Using a Hartree-Fock-Dispersion form with a modified damping function, three out of the four sets of data can be represented with a single potential function. Reaction Rates of Deuterium-Tritium Mixtures: two mixing chambers are being designed and built for studying D_2-T_2 and H_2-T_2. Low Temperature Trennschaukel: a bench model trennschaukel has been instrumented. II. Separation research covered Liquid Thermal Diffusion: Isotopic separations as functions of time were measured for methyl chloride, ethyl chloride, 1-chloropropane and 1-chlorobutane. The campaign to enrich chlorine-37 by liquid thermal diffusion of methyl chloride was concluded after 240 g of enriched isotope had been produced. Calcium Isotope Separation: Calcium isotope separation in the $Ca(NO_3)_2$-H_2O and -D_2O systems was measured using a 36.5 cm liquid phase thermal diffusion column. The largest separation was a 15% change in the calcium-48 abundance. Molecular Beam Scattering: a supersonic Ne beam through a cell containing Ar was used to measure low-energy, elastic, total cross sections of neon/argon in the velocity range of 4 to 10 (x 10^4) cm/s. Cross sections at onset of clustering were 7% higher than at minimum cluster conditions. Mutual Diffusion: Study continues on the temperature dependence of the mutal diffusion coefficients for binary noble gas mixtures, particularly argon with helium, neon, and xenon. Metal Chemical Exchange With Macrocyclic Ligands: The equilibrium single-stage separation factor was determined for two additional LiTFA/221 cryptand/$CHCl_3$ and two LiTFA/211 cryptand/$CHCl_3$ exchange systems.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 36319, 36988, 36995, 36996, 36998, 37190

37006 Multiple quantum NMR study of correlation of two methyl groups. Tang, J.; Pines, A. (Department of Chemistry, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W7405-ENG-48. *J. Chem. Phys.;* **73**: No. 5, 2512-2513(1 Sep 1980).

Multiple quantum NMR was used to study a system of two adjacent methyl groups in an oriented molecule to see if there was any degree of correlated motion. The 4-quantum spectrum which is sensitive to two-body correlations can distinguish simply between the cases of uncorrelated and correlated motion. The experimental multiple quantum spectra of partially oriented 2,3-dimethylmaleic anhydride in a liquid crystal show that the two methyl groups rotate quite independently.

37007 Thermal transformations of cis-1,2-dibenzoylalkenes. Chipman, D.M. (Univ. of Notre Dame, IN); Chauhan, S.M.S.; George, M.V. *J. Org. Chem.;* **45**: No. 16, 3187-3191(1 Aug 1980).

Thermal transformations of a few cis-1,2-dibenzoylalkenes such as 2,3-dibenzoylbicyclo[2.2.2]oct-2-ene (12), 2,3-dibenzoyl-7-oxabicyclo[2.2.1]hept-2-ene (16), and 2,3-dibenzoylbicyclo[2.2.1]hept-2-ene (19) have been examined. Thermolysis of 12 gave 2-benzoyl-3-phenylbicyclo[2.2.2]oct-2-ene (14) through the loss of CO from the lactone precursor 13. The thermolysis of 16, on the other hand, gave 3,4-dibenzoylfuran (17), through a fragmentation reaction. In contrast, the thermolysis of 19 gave 2-endo-3-exo-dibenzoylbicyclo[2.2.1]heptane (20), probably through a disproportionation reaction. Ab initio molecular orbital calculations were made on model compounds representing the conversion of cis-1,2-dibenzoylalkenes to the corresponding lactones to determine whether mechanisms involving intermediates such as the bicyclic structure 23, the dipolar structure 25, and the diradical structure 28 (Scheme IV) are feasible under thermal conditions. The bicyclic structure 23 is found to be easily accessible, lying between the starting material and final product in energy. Any mechanism involving the dipolar intermediate 25 seems to be less likely. The intermediate 28, which is geometrically similar to 25 but is of diradical rather than dipolar nature, is found to be comparable in energy to the starting material. It is concluded that the actual mechanism may then involve 23, 28, or perhaps even both of these.

37008 X-ray analysis, molecular structure, and nuclear magnetic resonance spectra of a dimer from 1,1-dichloro-2,5-diphenylcyclopropabenzene: (E)-2,2',3,3'-tetrachloro-4,4',7,7'-tetraphenyl-1,1'-bicycloheptatrienylidene. Fahey, J.A. (City Univ. of New York, Bronx); Huegel, H.M.; Kelly, D.P.; Halton, B.; Williams, G.J.B. *J. Org. Chem.;* **45**: No. 14, 2862-2865(4 Jul 1980).

The molecular structure of one of two dimers, $C_{38}H_{24}Cl_4$, produced by thermal reaction of 1,1-dichloro-2,5-diphenylcyclopropabenzene (1) has been revealed by crystallographic analysis to be a novel heptafulvalene, (E)-2,2',3,3'-tetrachloro-4,4',7,7'-tetraphenyl-1,1'-bicycloheptatrienylidene (10) in which the two seven-numbered rings are bent up facing each other. Previously reported spectroscopic data and new higher resolution NMR data can now be rationalized. 2 figures, 3 tables.

37009 Vapor phase association in acetic and trifluoroacetic acids. Thermal conductivity measurements and molecular orbital calculations. Frurip, D.J.; Curtiss, L.A.; Blander, M. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **102**: No. 8, 2610-2616(9 Apr 1980).

Thermal conductivity measurements are reported for the vapors of acetic acid and trifluoroacetic acid in the temperature range 350 to 415 K over the pressure range 100 to 2000 Torr. Very large enhancements of the thermal conductivity were found and analysis of the data is consistent with a monomer-dimer equilibrium for both vapors. The standard thermodynamic parameters for the dimerization reactions are $-\Delta H_2 = 14.64$ kcal mol^{-1} and $-\Delta S_2 = 35.50$ cal mol^{-1} K^{-1} for acetic acid, and $-\Delta H_2 = 13.66$ kcal mol^{-1} and $-\Delta S_2 = 36.15$ cal mol^{-1} K^{-1} for trifluoroacetic acid. No evidence was found for the presence of significant amounts of associated species larger than the dimer. Ab initio molecular orbital calculations were performed on the monomers and dimers of both acids to determine the lowest energy structures.

37010 Correlating phosphorus core binding energies, phosphorus lone pair ionization potentials, and proton affinities of tervalent phosphorus compounds. Lee, T.H. (Univ. of California, Berkeley); Jolly, W.L.; Bakke, A.A.; Weiss, R.; Verkade, J.G. Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 8, 2631-2636(9 Apr 1980).

Phosphorus core binding energies have been determined for a wide variety of tervalent phosphorus compounds. These values are compared with literature values of the corresponding lone pair ionization potentials and proton affinities. No single correlation is found between all the core binding energies and the corresponding lone pair ionization potentials or proton affinities, but the lone pair ionization potentials are linearly correlated with the proton affinities. It is concluded that the electronic relaxations accompanying lone-pair ionization and proton attachment are similar in character and energy, whereas the electronic relaxation accompanying core ionization is of a somewhat different type, in which atomic orbital rehybridization plays a relatively unimportant role.

37011 Applicability of the second-derivative method to room-temperature phosphorescence analysis. Vo-dinh, T.; Gammage, R.B. (Oak Ridge National Lab., TN). *Anal. Chim. Acta;* **107**: 261-271(1979).

The use of the second-derivative (d^2) technique to overcome some of the problems encountered in room-temperature phosphorescence analysis is investigated. Despite some reduction in the signal-to-noise values, the d^2-technique was shown to be particularly suited to improving the selectivity of the assay. The utility of this method for applications in multicomponent mixture analysis is discussed. The two most significant figures of merit for room-temperature phosphorescence are the reduction of spectral overlap and the decrease of backgroun interference.

37012 Non-planarity of hydroxamic acids. Structures of 3-hydroxyxanthine dihydrate by x-ray diffraction and hydroxyurea by neutron diffraction. Thiessen, W.E.; Levy, H.A.; Flaig, B.D. (Oak Ridge National Lab., TN). *Acta Crystallogr., Sect. B;* **34**: 2495-2502(1978).

The crystal structures of 3-hydroxyxanthine dihydrate and hydroxyurea both display pyramidality at the N atom to which the hydroxyl group is attached. The effect is measured by a 0.19 A displacement of the hydroxyl O atom from the best plane of the aromatic ring in 3-hydroxyxanthine, and by a 0.23 A displacement of the H atom bound to hydroxylated N from the best plane through the heavy atoms in hydroxyurea. The effect appears to be characteristic of hydroxamine acids. An explanation in terms of molecular bonding is proposed. Crystal data based on $\lambda(Cu\ K\alpha_1) = 1.54051$ A and some particulars of the structure determination follow. 3-Hydroxyxanthine dihydrate: triclinic, P anti 1, Z = 2, cell parameters changed with x-ray exposure; stable values and precision measures after ~ 100 h exposure are a = 7.8383 (1), b = 8.4054 (2), c = 7.4408 (1) A, cos a = -0.41039 (2), cos β = -0.32227 (3), cos γ = 0.40919 (3), α = 114.229 (1), β = 108.800 (2), γ = 65.846 (2)°, t =

23 +- 2°C. Solution by reiterative application of Sayre's equation, least squares refinement, 2138 observations, R(F) = 0.038. Hydroxyurea: monoclinic, $P2_1/c$, a = 8.3962 (2), b = 4.9026 (2), c = 8.8060 (2) A, cos β = -0.51820 (2), β = 121.212 (1)°, t = 24°C. The H atoms of the hydroxyurea structure were precisely located by neutron diffraction; least-squares refinement, 1955 observations, R(F) = 0.042. 6 figures, 6 tables.

37013 Laser-induced time-resolved phosphorescence of oxalyl fluoride ^{3}A/sub u/ molecules. Karl, R.R. Jr.; Wampler, F.B.; Oldenborg, R.C.; Rice, W.W. (Los Alamos Scientific Lab., NM). *J. Photochem.;* **9**: 407-409(1978).

Preliminary findings are reported for the laser-induced time-resolved quenching of the ^{3}A/sub u/ state of fluorinated carbonyls $(COF)_2$. 2 figures.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 37004

37014 Resonance absorption measurements of atom concentrations in reacting gas mixtures. III. Pyrolysis of CD_4 behind shock waves. Chiang, C.C.; Baker, J.A.; Skinner, G.B. (Wright State Univ., Dayton, OH). Contract EY-76-S-02-2944. *J. Phys. Chem.;* **84**: No. 9, 939-944(1 May 1980).

Dilute mixtures (10 to 100 ppM) of CD_4 in argon were pyrolyzed behind reflected shock waves at temperatures of 1780 to 2440 K and total pressures of 2 to 3 atm. Progress of the reaction was followed by analysis for D atoms by using resonance absorption spectroscopy. Rate constants were determined as follows: $CD_4 \rightarrow CD_3 + D$, $k_1 = 1.4 \times 10^{11} \exp(-81000/RT)\ s^{-1}$; $CD_4 + Ar \rightarrow CD_3 + D + Ar$, k/sub 1a/ = $2.1 \times 10^{16} \exp(-84900/RT)\ mol^{-1}\ cm^3\ s^{-1}$; $D + CD_4 \rightarrow D_2 + CD_3$, $k_2 = 2.1 \times 10^{15} \exp(-22300/RT)\ mol^{-1}\ cm^3\ s^{-1}$, where activation energies are in calories. These data have been correlated with similar data by Roth and Just on pyrolysis of CH_4, with laser schlieren data by Tabayashi and Bauer on pyrolysis of CH_4 and CD_4, and with other data on CH_4 pyrolysis, via RRKM and activated complex theory calculations.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

37015 (LBL—10000, pp 497-507) **Advanced isotope separation technology.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Multiphoton dissociation (MPD) for laser isotope separation was studied. MPD of the following compounds were studied: ethyl chloride, formaldehyde, CF_3CDCl_2, CF_2Cl_2, and ethyl vinyl ether. Vibrational predissociation spectra of HF and HF-DF clusters were also obtained. (DLC)

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 37028

37016 Laser induced photoelectrochemistry. Dependence of photoemission-related currents on laser characteristics. Richardson, J.H. (Univ. of California, Livermore); George, S.M.; Harrar, J.E.; Perone, S.P. *J. Phys. Chem.;* **82**: No. 16, 1818-1827(1978).

Two laser systems have been used to study photorelated currents arising from irradiation of a dropping mercury electrode. The two laser systems, a nitrogen pumped dye laser and a continuous wave argon ion laser, provided both a high power, low energy and a low power, high energy source. Detection of signals was accomplished by dc polarography, boxcar signal averaging and oscilloscope display. Solutions containing no electron scavengers, simple electron scavengers (e.g., N_2O, NO_3^-), and complex electron scavengers (transition metal ions) were examined. Unusual photorelated currents were observed, many attributable to the high peak powers used. Tunability proved to be a great asset in separating Faradaic from non-Faradaic currents. Dependence of photorelated currents on electrode potential, wavelength, scavenger, and laser intensity are presented. The advantages and disadvantages of laser irradiation for photoelectrochemistry are discussed and illustrated. 15 figures.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 36199, 37013, 37016, 37019

37017 Photochemistry of aliphatic ketones in polar solvents. Encinas, M.V. (Univ. of Notre Dame, IN); Lissi, E.A.; Scaiano, J.C. *J. Phys. Chem.;* **84**: No. 9, 948-951(1 May 1980).

The photochemistry of several aliphatic ketones has been examined by using a combination of laser flash photolysis, quantum yield, and luminescence techniques. The results provide detailed information on the kinetics of transient processes. The laser flash experiments were carried out with a krypton-fluorine excimer laser capable of producing high-energy pulses at 248 nm. For example, in the case of 2-pentanone in water a triplet lifetime of 62 ns and a quantum yield of type II fragmentation of 0.43 was obtained, and was observed that all triplet-derived biradicals proceed to products; rate constants for the type I and type II processes were also obtained. In the case of 5-methyl-2-hexanone, preliminary evidence suggests that the species detected in the flash experiments is the type II biradical, not the triplet state.

37018 Photochemical method for generating superoxide radicals (O_2-) in aqueous solutions. Holroyd, R.A.; Bielski, B.H.J. (to Dept. of Energy). US Patent 4,199,419. 22 Apr 1980. Filed date 28 Dec 1978. 10p.

PAT-APPL-973,845.

This patent describes a photochemical method and apparatus for generating superoxide radicals (O_2-) in an aqueous solution by means of a vacuum-ultraviolet lamp of simple design. The lamp is a microwave powered rare gas device that emits far-ultraviolet light. The lamp includes an inner loop of high purity quartz tubing through which flows an oxygen-saturated sodium formate solution. The inner loop is designed so that the solution is subjected to an intense flux of far-ultraviolet light. This causes the solution to photodecompose and form the product radical (O_2-).

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 36143, 36192, 36842, 36843

37019 (ORO—3106-73) **Radiation chemistry of hydrocarbon and alkyl halide systems. Progress report, August 30, 1979-July 31, 1980.** Hanrahan, R.J. (Florida Univ., Gainesville (USA)). 1980. Contract AS05-76ER03106. 26p. NTIS, PC A03/MF A01.

This progress report covers experiments on pulse radiolysis of methyl iodide, radiation induced reactions in H_2-CO mixtures and photochemistry and mass spectrometry of CF_3I-CH_3I systems. In the pulse radiolysis of alkyl iodide, it was possible to follow rate processes involving atomic iodine in the ^{2}P/sub 1/2/ excited state and ^{2}P/sub 3/2/ ground state resulting from irradiation of these compounds. The excited state proved easy to follow, since it can be observed in a strong transition at 206.2 nm. Observation of atomic iodine in the ^{2}P/sub 3/2/ ground state proved difficult, since it must be observed at 178.3 nm, well into the vacuum ultraviolet. Several design improvements in the pulse radiolysis apparatus were made to achieve a reliable measurement of the I*/I production ratio. The physical arrangement of the apparatus which was adopted is illustrated. A remaining problem which stands in the way of measuring I*/I ratios is the lack of information on extinction coefficients of ^{2}P/sub 1/2/ and ^{2}P/sub 3/2/ atomic iodine at 206 and 178 nm. It is expected that indirect calculations and/or computer modelling will be employed. In the H_2-CO system, investigation of the effect of total pressure in the homogeneous gas phase was made, concentrating on the 3:1 H_2-CO mixtures. Measurements were made as a function of pressure in the range of 250 to 3300 torr for saturated and unsaturated hydrocarbon in the C_1 to C_6 range. Two trends were exhibited; yields of all products dropped markedly as system pressure was increased; and yields in the nickel vessels were generally in excess of yields in the stainless vessels. Photolysis of CF_3I-CH_3I gas phase showed a substantial yield of the product CH_2I_2. High pressure mass spectrometry of CF_3-CH_3I mixtures revealed $(CH_3ICH_3)^+$, I_2^+, $CF_3I_2^+$, $(CF_3I)_2^+$, and unique species such as CF_3ICH_3 and $CF_2ICH_2^+$.

37020 Alkoxy radicals: γ proton hyperfine couplings. Box, H.C.; Budzinski, E.E.; Potienko, G. (Department of Biophysics, Roswell Park Memorial Institute, Buffalo, New York 14263). *J. Chem. Phys.;* **73**: No. 5, 2052-2056(1 Sep 1980).

The relationship between γ proton hyperfine couplings and conformation in alkoxy radicals was investigated. It is shown that large γ proton couplings are present in alkoxy radicals in which significant spin polarization of the C/sub β/—C/sub γ/ bonding orbitals is expected. This principle finds application in analyzing the proton hyperfine couplings observed for the alkoxy radical in irradiated deoxycytidine monophosphate. The g tensor and hyperfine coupling tensors which characterize this radical were determined from ESR and ENDOR measurements.

37021 Temperature dependence of the triplet lifetimes of some aryl iodides and bromides. Grieser, F.; Thomas, J.K. (Chemistry Department and Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *J. Chem. Phys.;* **73**: No. 5, 2115-2119(1 Sep 1980).

A variable temperature pulse radiolysis study of the triplet state of iodonaphthalene and iodobiphenyl indicates that an intramo-

lecular energy relocation process is inhibited as the temperature is lowered from 20 °C, resulting in a lengthening of the lifetime of the triplet state. It is postulated that the triplet state energy of these aryl iodides is channeled into the C—I bond, causing bond dissociation. The activation energies for this process, in toluene, have been measured to be 5.9, 4.8, and 3.4 kcal/mole for 1-iodonaphthalene, 2-iodonaphthalene and 4-iodobiphenyl, respectively. Similar experiments with aryl bromides in toluene, at temperatures greater than 20 °C, are also interpreted as indicating the dissociation of the C—Br bond from the triplet state. For 4-bromobiphenyl and 4,4'-dibromobiphenyl the activation energy is in the range of 10—13 kcal/mole. The results are discussed in relation to the work of Bersohn and coworkers.

37022 Reaction between superoxide ion and the superoxide coordinated in a cobalt(III) complex. Natarajan, P. (Univ. of Notre Dame, IN); Raghavan, N.V. *J. Am. Chem. Soc.;* **102**: No. 13, 4518-4519(18 Jun 1980).

Reactions between the O_2^-. have been investigated in the transition-metal complexes, μ-amino-μ-superoxo-bis[bisethylenediamine cobalt(III)] and μ-superoxo-bis(pentacyano)cobalt(III). After production of the superoxide ion by pulse radiolysis of aqueous solutions, saturated with oxygen, containing 0.1M sodium formate, the reaction with the complex was followed by monitoring the formation of the peroxo complex using spectrometric pulse radiolysis techniques. Results of these studies indicate that the coordination of the superoxide with cobalt(III) has the same effect as the hydrogen ion in the superoxide dismutation reaction: $2O_2^-. + 2H^+ \rightarrow O_2 + H_2O_2$. (BLM)

37023 Negative activation energy for the self-reaction of HO_2 in the gas phase. Dimerization of HO_2. Lii, R.R.; Gorse, R.A. Jr.; Sauer, M.C. Jr.; Gordon, S. (Argonne National Lab., IL). *J. Phys. Chem.;* **83**: 1803-1804(1979).

Measurements of the rate constant for the self-reaction of hydroperoxyl radical, HO_2, were made over the temperature range of 276-400°K. A pulse radiolysis technique using a 50-ns electron pulse of about 2-MeV incident energy in a system of 1200 torr of H_2 and 5 torr of O_2 created H atoms which were entirely converted to HO_2 within a few microseconds. The slower disappearance of the HO_2 radical was followed over ca. 1 ms by kinetic spectrophotometry at 230 nm. The negative activation energy for the reaction, $HO_2 + HO_2 \rightarrow H_2O_2 + O_2$, was explained on the basis of an unstable dimer intermediate H_2O_4.

37024 Electron spin resonance studies of fluorine-containing radicals in single organic crystals. Kispert, L.D. (Univ. of Alabama, Tuscaloosa). *ACS Symp. Ser.;* No. 66, 349-385(1978).

This paper reviews the important structural features of fluorine-containing radicals oriented in irradiated single crystals. It will also be demonstrated that these radicals undergo a dynamic motion over a wide range of temperatures, that oxygen can diffuse into a number of these irradiated crystals forming peroxy radicals, and that a complete radical formation and decay mechanism is not known. 44 references, 14 figures, 6 tables.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

37025 (LA—8337-MS) Nuclear-radiation measurement facilities at the radiochemistry laboratory at LASL. Balagna, J.P. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01.

A brief description is given of the radiation counting facilities and different types of systems used by the CNC-11 radiochemistry group at the Los Alamos Scientific Laboratory.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 36138

37026 (LBL—10000, pp 431-472) Low energy nuclear sciences. Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Topics covered include: specific sequestering agents for the actinides; synthetic and structural studies of actinides and other compounds; and physical and spectroscopic studies.

37027 Synthesis and structure of two crystalline forms of (Cyclooctatetraene)thorium(IV) dichloride-bis(tetrahydrofuran). Zalkin, A.; Templeton, D.H.; Le Vanda, C.; Streitwieser, A. Jr. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Inorg. Chem.:* **19**: No. 9, 2560-2563(Sep 1980).

$Th(C_8H_8)Cl_2(OC_4H_8)_2$ crystallizes in two modifications. The α form, space group $P2_1/n$, has dimensions a = 8.589 (4) A, b = 27.222 (10) A, c = 7.950 (4) A, β = 96.92 (5)°, Z = 4, and d/sub x/ = 1.99 g/cm³. The β form, space group $P2_1/c$, has dimensions a = 13.036 (6) A, b = 11.601 (6) A, c = 24.598 (10) A, β = 102.90 (5)°, Z = 8, and d/sub x/ = 2.02 g/cm³. The α form has one molecule in the asymmetric unit whereas the β form has two which are chemically equivalent but crystallographically different. The study thus yields three independent determinations of the same molecular structure. Thorium is bonded to the cyclooctatetraene ring, to two chlorine atoms, and to two oxygen atoms from the tetrahydrofuran moieties. Significant distances (averaged) are Th-Cl = 2.69 A, Th-O = 2.57 A, and Th-to-plane of C_8H_8 = 2.02 A.

37028 Electrochemical and spectroscopic studies of uranium(IV), -(V), and -(VI) in carbonate-bicarbonate buffers. Wester, D.W.; Sullivan, J.C. (Argonne National Lab., IL). *Inorg. Chem.;* **19**: No. 9, 2838-2840(Sep 1980).

Recently a need for more detailed knowledge of the chemistry of actinide ions in basic media has arisen in connection with deducing their chemistry in the environment. In this work the results of polarographic, cyclic voltammetric, and spectroscopic studies of U(IV), -(V), and -(VI) in carbonate and bicarbonate media are reported. Polarographic studies were in excellent agreement with those reported previously. Cyclic voltammetric scans confirmed the irreversible reduction to U(V) in both solutions, but disproportionation of the U(V) was observed only in the bicarbonate solutions. The oxidation of U(V) in carbonate was followed spectroscopically for the first time. Reduction in bicarbonate produced U(IV), the spectrum of which is now reported and the oxidation of which was also followed spectroscopically for the first time.

37029 Decontaminating metal surfaces. Childs, E.L.; Long, J.L. (to Dept. of Energy). US Patent 4,193,853. 18 Mar 1980. Filed date 15 May 1979. 4p.

PAT-APPL-39,428.

A method is described for electrolytically removing surface radioactive contamination from a metal object by removing a layer of the metal in an electrolytic bath and separating the precipitate so formed. The electrolyte consists of a basic aqueous solution containing nitrate, fluoride, barate, and oxalate anions. The method is especially applicable to the removal of surface plutonium contamination. (BLM)

RADIOISOTOPE PRODUCTION

37030 (CONF-800814—15) Multigram group separation of actinide and lanthanide elements by LiCl-based anion exchange. Collins, E.D.; Benker, D.E.; Chattin, F.R.; Orr, P.B.; Ross, R.G. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

The laboratory-scale LiCl AIX process has been successfully adapted to the multigram scale and has been used effectively in transuranium element production campaigns to separate the lanthanide fission products from the transplutonium actinides and to partition americium and curium from the heavier elements. Corrosion of the tantalum and glass equipment has been negligible. Although radiolytic gas generation has not caused a problem, radiation exposure of the Dowex 1-X10 anion exchange resin does occur significantly. However, the 1.3-L resin bed can be used successfully to process up to 3 batches, each containing 19 g of ^{244}Cm (54 W of decay heat). The chromatographic elution process is controlled by use of an alpha detector in the column effluent line and by periodic measurement of the neutron profile of the column. The development and use of feed pretreatment and operating methods has enabled effective and dependable operation.

37031 (CONF-800814—21(Draft)) Experience in the separation and purification of transplutonium elements in the transuranium processing plant at the Oak Ridge National Laboratory. King, L.J.; Bigelow, J.E.; Collins, E.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Since 1966, TRU has been the main center of production for transcurium elements in the US, producing 460 mg ^{249}Bk, 4 g ^{252}Cf, 18 mg ^{253}Es, and 10 pg ^{257}Fm. During the 14 years operation, 39 chemical processing campaigns were conducted to process 265 HFIR targets and 195 SRP production reactor targets. (DLC)

37032 (CONF-800814—23(Draft)) Chromatographic cation exchange separation of decigram quantities of californium and other transplutonium elements. Benker, D.E.; Chattin, F.R.; Collins, E.D.; Knauer, J.B.; Orr, P.B.; Ross, R.G.; Wiggins, J.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

Decigram quantities of highly radioactive transplutonium elements are routinely partitioned at TRU by chromatographic elution from cation resin using AHIB eluent. By using two high-pressure ion exchange columns, a small one for the initial loading of the feed and a large one for the elution, batch runs containing up to 200 mg of ^{252}Cf can be made in about 5 hours (2 hours to load the feed and 3 hours for the elution). The number of effluent product fractions and the amount of actinides that must be collected in intermediate fractions are minimized by monitoring response from a flow-through alpha-detector. This process has been reliable and relatively easy to operate, and will continue to be used for partitioning transplutonium elements at TRU.

37033 (CONF-800870—2) **Basic studies of a gas-jet-coupled ion source for on-line isotope separation.** Anderl, R.A.; Novick, V.J.; Greenwood, R.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 33p. NTIS, PC A03/MF A01.

From 10. international conference on electromagnetic isotope separators; Zinal, Switzerland (31 Aug 1980).

A hollow-cathode ion source was used in a gas-jet-coupled configuration to produce ion beams of fission products transported to it from a ^{252}Cf fission source. Solid aerosols of NaCl and Ag were used effectively as activity carriers in the gas-jet system. Flat-plate skimmers provided an effective coupling of the ion source to the gas jet. Ge(Li) spectrometric measurements of the activity deposited on an ion-beam collector relative to that deposited on a pre-skimmer collector were used to obtain separation efficiencies ranging from 0.1% to $>$ 1% for Sr, Y, Tc, Te, Cs, Ba, Ce, Pr, Nd and Sm. The use of CCl_4 as a support gas resulted in a significant enhancement of the alkaline-earth and rare-earth separation efficiencies.

37034 **Hot cell purification of strontium-82, 85 and other isotopes from proton irradiated molybdenum.** Bentley, G.E.; Barnes, J.W. (to Dept. of Energy). US Patent Application 086,021. 17 Oct 1979. 17p.

A process suitable for producing curie quantities of quite pure Sr-82,85 is given. After a Mo target is irradiated with energetic protons having energies greater than about 200 MeV, thus producing a large number of radioactive species, the particular species of Sr-82,85 are substantially separated from the other products by a 6-step process. The process comprises dissolution of the target in H_2O_2, followed by use of several ion exchange resins, extraction with an organophosphorus compound, and several adjustments of pH values. Other embodiments include processes for producing relatively pure long-lived Rb isotopes, Y-88, and Zr-88.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

37035 (AD-A—079657/3) **Atomic and molecular gas phase spectrometry. Final scientific report 1 Sep 75-30 Sep 79.** Winefordner, J.D. (Florida Univ., Gainesville (USA). Dept. of Chemistry). 1979. Contract F44620-76-C-0005. 45p. NTIS, PC A03/MF A01.

The research is divided into combustion diagnostics and analytical gas phase atomic and molecular spectrometry. New and improved techniques to spatially and temporally measure flame gas temperatures and species have been and are being developed. These techniques are all based upon fluorescence detection. By measuring the ratio of two fluorescence transitions (in a probe, such as indium) excited with two different wavelengths, the flame temperature can be measured with a precision and accuracy better than 50 K. The two main temperature techniques developed depend upon either the linear relationship between Fluorescence and the excitation flux on the approach to saturation of the fluorescence with high excitation fluxes. The measurement of total species concentrations in flames and fluorescence quantum efficiencies is readily performed by measurement of the absolute fluorescence flux reaching a calibrated detector as a function of absolute laser flux. A rather simple graphical method allows both species concentration and species fluorescence quantum efficiencies to be measured.

37036 (ANL/CEN/FE—80-11) **Sampling and analysis of hydrocarbons in combustion gases. Quarterly report, April-June 1980.** Johnson, I.; Myles, K.M.; Siczek, A.A. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01.

The purpose of these studies is to develop a methodology for the chemical analysis of ultratrace levels of polycyclic organic compounds in the flue gases from fluidized-bed combustors. A brief review of current analytical methods has been made. Alternative methods, which have the potential for real time analysis, have been studied. Two methods, atmospheric-pressure chemical ionization followed by mass spectrometry and dual mass spectrometry, appear promising.

37037 (ARI-RR—177) **PACKAGE (Plasma Analysis, Chemical Kinetics and Generator Efficiency): a computer program for the calculation of partial chemical equilibrium/partial chemical rate controlled composition of multiphased mixtures under one dimensional steady flow.** Yousefian, V.; Weinberg, M.H.; Haimes, R. (Aerodyne Research, Inc., Bedford, MA (USA)). Feb 1980. Contract AC01-76ET10775. 576p. NTIS, PC A25/MF A01.

The NASA CEC Code was the starting point for PACKAGE, whose function is to evaluate the composition of a multiphase combustion product mixture under the following chemical conditions: (1) total equilibrium with pure condensed species; (2) total equilibrium with ideal liquid solution; (3) partial equilibrium/partial finite rate chemistry; and (4) fully finite rate chemistry. The last three conditions were developed to treat the evolution of complex mixtures such as coal combustion products. The thermodynamic variable pairs considered are either pressure (P) and enthalpy, P and entropy, at P and temperature. Minimization of Gibbs free energy is used. This report gives detailed discussions of formulation and input/output information used in the code. Sample problems are given. The code development, description, and current programming constraints are discussed. (DLC)

37038 (FE—2252-15) **Fate of fuel-sulfur in backmixed combustion systems. Final report, August 1979-January 1980.** Malte, P.C.; Kramlich, J.C.; Grosshandler, W.L. (Washington State Univ., Pullman (USA). Dept. of Mechanical Engineering). Jun 1980. Contract AC01-76ET10613. 170p. NTIS, PC A08/MF A01.

Comprehensive sulfur species measurements were performed on combustion gases in a premixed, jet-stirred reactor containing 0.23 mole % total sulfur. Species measured were H_2S, COS, CS_2, C_4H_4S, SO_2, O_2, CH_2, and C_2H_2 by gas chromatography; relative SH and CS and absolute OH by uv absorption spectroscopy; and SO_3 by controlled condensation. Reactor fuels were C_3H_8, C_2H_2, CH_4, H_2, and a H_2/CO mixture. Sulfur dopants were C_4H_4S, H_2S, and SO_2. Reactor conditions were $1600 \leqq T \leqq 1800°K$, $0.7 \leqq PHI \leqq 1.7$, and $3.5 \leqq$ tau $\leqq 7$ ms. Pressure was 0.9 atm, except for SO_3 measurements at $0.9 \leqq P \leqq 2.9$ atm. SO_2 was always the dominant product. In fuel-rich flames lacking significant hydrocarbons, H_2S was the stable non-SO_2 product sampled - of order 5% yield. In hydrocarbon flames at richer conditions, COS and CS_2 replaced H_2S as the non-SO_2 product. Kinetic interpretation indicated that internal equilibration of the S-H-O subsystem occurred and that H_2S, COS and CS_2 likely formed within the sample probe through reaction of SO. The SO_3 measurements, in conjunction with inference of O-atom concentrations from measured OH, indicated that the reaction $SO_2 + O + M \rightarrow SO_3 + M$ predicts SO_3 formation provided that a second order pressure limit of 0.3 atm is assumed. A pulverized coal combustion reactor was also used to study the behavior of sulfur. The combustion chamber burned a mass mixture of half propane and half pulverized coal in a recirculating flame with a thermal output of 5 to 9 kW. Temperature and concentrations of SO_2, H_2S, CO, CO_2 and O were mapped throughout the combustion chamber for Utah coal burned at fuel-air equivalence ratios of PHI = 0.9, 1.2, and 1.6.

37039 (SAND—80-1900C) **Observations of vaporizing water-in-fuel emulsion droplets.** Sheffield, S.A.; Baer, M.R.; Denison, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 4p. (CONF-801118—2). NTIS, PC A02/MF A01.

From Fall technical meeting eastern section: the Combustion Institute; Princeton, NJ, USA (12 Nov 1980).

These observations in a Leidenfrost-type experiment allowed one to distinguish between different mechanisms in the emulsion combustion process. Three events were observed: disruptions, heterogeneously nucleated vapor explosions, and homogeneously nucleated vapor explosions. The last event greatly enhances combustion. The cenospheres, carbospheres or oil-coke particles formed will be reduced or eliminated by the vapor explosions, and any small solid fragments are likely to be consumed in the enhanced combustion processes. (DLC)

ENGINEERING

GENERAL ENGINEERING

37040 (SAND—80-2034C) **National and international drawing standards: moving toward better alignment with Y14.5.** Nicovich, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 24p. (CONF-801051—1). NTIS, PC A02/MF A01.

From 75. SAE anniversary aerospace congress; Los Angeles, CA, USA (13 Oct 1980).

The task of revising the national standard on Dimensioning and Tolerancing, begun seven years ago, required close coordination between the Y14.5 Subcommittee and the US expert members who

participated in related activities of the International Organization for Standardization. The revised drawing standard about to be issued reflects additional international alignments in areas of metrication, symbology, and conventions. Differences remain in the prescribed symbol for indicating a datum feature and in a Principle of Independency, the latter unacceptably absolving size limits from controlling the geometric form of an individual feature. More US member experts will be needed on the Y14.5 Subcommittee to uphold US viewpoints in the writing of international drawing standards of a pragmatic kind.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 36090

37041 (BDX—613-2418) **Deburring small intersecting holes.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Aug 1980. Contract AC04-76DP00613. 49p. NTIS, PC A03/MF A01.

Deburring intersecting holes is one of the most difficult deburring tasks faced by many industries. Only 14 of the 37 major deburring processes are applicable to most intersecting hole applications. Only five of these are normally applicable to small or miniature holes. Basic process capabilities and techniques used as a function of hole sizes and intersection depths are summarized.

37042 (DOE/PE—03871-01, pp 21.1-21.20) **Heat transport by heat pipes.** Nov 1979.

In Distributed energy systems: a review of related technologies.

Heat pipes transport high-flux heat energy from a source of heat to a point of application and have potential use in industrial heat recovery systems, coal gasifying plants, Stirling engine energy systems, and solar systems. The design, construction, operation, and economics of heat pipes, and current research to develop high-temperature heat pipes capable of handling temperatures in excess of 2000°F are discussed. (LCL)

37043 (KAPL—4121) **Fluid-resonator response to hydrodynamic pressure oscillations.** Pollack, M.L. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Feb 1980. Contract AC12-76SN00052. 31p. (CONF-801102—13). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A technique for predicting the one-dimensional acoustic response of a fluid resonator to hydrodynamic pressure excitation by means of an impedance method is presented. The pressure excitation is simulated by virtual pressure sources, and a pipe excited by such sources is presented as a sample case. The dependence of the response on the source distribution (i.e., correlation length) is examined. Further work necessary to extend the analysis capability to include the normal-mode and statistical-turbulence methods is outlined.

37044 (UCID—18643) **High pressure gas metering project.** Tripp, L.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jul 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

The initial research and development of a system that uses high pressure helium gas to pressurize vessels over a wide range of pressurization rates, vessel volumes, and maximum test pressures are described. A method of controlling the mass flow rate in a test vessel was developed by using the pressure difference across a capillary tube. The mass flow rate is related to the pressurization rate through a real gas equation of state. The resulting mass flow equation is then used in a control algorithm. Plots of two typical pressurization tests run on a manually operated system are included.

37045 (UCRL—84311) **Unsteady boundary-layer flows in combustion environments.** Kang, S.W.; Levatin, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1980. Contract W-7405-ENG-48. 10p. (CONF-800956—1). NTIS, PC A02/MF A01.

From 17. JANNAF combustion meeting; Hampton, VA, USA (22 Sep 1980).

Current progress is described in the calculation of nonsteady boundary layers connected with internal flows for the purpose of discovering the principal wall erosion mechanisms. A time-dependent system of equations describing the laminar and turbulent viscous layer is solved numerically by means of an alternating-direction-implicit (ADI) scheme for prescribed transient and streamwise-varying core flow conditions. Validity of the method is demonstrated by comparison of present results with those obtained by previous analyses. Earlier calculations of compressible turbulent flow cases showed that high heat fluxes at the wall due to turbulence and changing core conditions could bring about severe temperature rise at the wall. Present results indeed display a marked rise in wall temperature which may cause melting and ablation, and hence erosion of the surface.

37046 **Automated flow-temperature-humidity control system.** Nelson, G.O.; Taylor, R.D. (Univ. of California, Livermore). *Am. Ind. Hyg. Assoc. J.;* **41**: No. 10, 769-771(Oct 1980).

An automated system that controls air flow, temperature, and humidity was developed from a commercially available temperature-humidity indicator and a specially built flow-temperature-humidity control module. Parameters are set using direct-reading dials on the control module. The air flow is maintained using a mass-flow controller while process controllers connected to the indicator regulate humidity and temperature. The system will run indefinitely without need for operator intervention. If the module and indicator are calibrated properly, accurate air flows (+-2% of full scale), temperatures (+-0.3°C), and humidities (+-2% RH) can be achieved.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 36642, 36897, 36951, 37430, 37431

37047 (LA-UR—80-2731) **Conductor qualification tests for the 30-MJ Bonneville Power Administration SMES coil.** Schermer, R.I.; Boenig, H.J.; Henke, M.; Turner, R.D.; Schramm, R. (Los Alamos Scientific Lab., NM (USA); National Bureau of Standards, Boulder, CO (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800980—4). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The 30-MJ energy storage coil for the Bonneville Power Administration requires a low-loss, cryostable conductor that is able to carry 4.9 kA in a field of 2.8 T and will maintain its properties over 10^5 partial discharge cycles. The multi-level cable which satisfies these requirements has been extensively tested at various stages in its development and in its final form. Tests have been performed to determine the effect of manufacturing options on ac losses, low temperature electrical resistivity, stability, and fatigue resistance of the insulated conductor. This paper will concentrate on the stability and fatigue tests which have not previously been reported.

37048 (LA-UR—80-2774) **High-field bipolar loss measurement apparatus.** Thullen, P.; Weldon, D.; Wollan, J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800980—7). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

An apparatus was constructed to measure dissipation in superconducting wire in high alternating fields. The apparatus will be used to make measurements on conductors which must operate in fields up to 7.0 T and rates of field change up to 15 T/s. The magnet for this facility is wound of uninsulated, 15 strand Rutherford cable in which the strand is a 0.812 mm diameter, fully mixed matrix, Cu plus CuNi, multifilament NbTi conductor. The coil is wound in a bath cooled configuration with an overall current density of 7.8 kA/cm^2. The circuit incorporates a pair of locomotive traction motors as the capacitive circuit element for the bipolar swing. The design, construction and operating characteristics of the field coil and the associated circuitry are described.

37049 (UCRL—84110) **Reliability of large superconducting magnets through design.** Henning, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1980. Contract W-7405-ENG-48. 9p. (CONF-800980—3). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

As superconducting magnet systems grow larger and become the central component of major systems involving fusion, magnetohydrodynamics, and high-energy physics, their reliability must be commensurate with the enormous capital investment in the projects. Although the magnet may represent only 15% of the cost of a large system such as the Mirror Fusion Test Facility, its failure would be catastrophic to the entire investment. Effective quality control during construction is one method of ensuring success. However, if the design is unforgiving, even an inordinate amount of effort expended on quality control may be inadequate. Creative design is the most effective way of ensuring magnet reliability and providing a reasonable limit on the amount of quality control needed. For example, by subjecting the last drawing operation is superconductor manufacture to a stress larger than the magnet design stress, a 100% proof test is achieved; cabled conductors offer mechanical redundancy, as do some methods of conductor joining; ground-plane insulation should be multilayered to prevent arcs, and interturn and interlayer insulation spaced to be compatible with the self-extinguishing of arcs during quench voltages; electrical leads should be thermally protected; and guard vacuum spaces can be incorporated to control helium leaks. Many reliable design options are known to magnet designers. These options need to be document-

ed and organized to produce a design guide. Eventually, standard procedures, safety factors, and design codes can lead to reliability in magnets comparable to that obtained in pressure vessels and other structures. Without such reliability, large-scale applications in major systems employing magnetic fusion energy, magnetohydrodynamics, or high-energy physics would present unacceptable economic risks.

37050 Performance of in situ superconductors in solenoids. Ostenson, J.E.; Finnemore, D.K.; Verhoeven, J.D.; Gibson, E.D. (Ames Laboratory, Department of Physics and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Appl. Phys. Lett.;* 37: No. 7, 662-664(1 Oct 1980).

A series of small solenoids have been wound from in situ prepared Nb_3-Sn-Cu superconducting wire in order to determine the suitability of these materials for magnets which require bending strains greater than 2% at the surface of the wire. In the range from 4 to 14 T, J/sub c/ of the solenoid is equivalent to or exceeds performance for unstrained material. For best performance in ac fields, it is essential to twist the wire and to support the windings with a potting material. Calorimetric measurements of the ac losses in the 8—12 T range give 1 mW/cm^3 for magnetic fields ramped at 1 T/s.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 36069

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 36094, 36111, 36140

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 35921, 35956

LASERS

REFER ALSO TO CITATION(S) 36416, 37441

37051 (AD-A—079595/5) **Kinetic rate constants for mercury halide lasers. Interim technical report.** Collins, G.J. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). 29 Oct 1979. Contract N00014-78-C-0266,. 14p. NTIS, PC A02/MF A01.

This research is directed towards the measurement of total quenching rates for the Hg(6s6p) levels with a variety of chlorine and bromine halogen bearing molecules. This information is important to the development of more efficient mercury halide lasers. The objectives are to identify optimum halogen donors for all three lasers HgBr, HgCl, and HgI. An attempt has been made to pump these blue-green lasers in a more conventional technique, such as flash lamp pumping. Research is continuing to uncover other blue-green laser systems through photodissociation and optical pumping of metal halides.

37052 (AD-A—079596/3) **Theoretical studies of electronic transition lasers. Annual report for fy 1979.** Krauss, M.; Stevens, W.J. (National Bureau of Standards, Washington, DC (USA). Quantum Chemistry Group). 1979. Contract N00014-79-F-0043. 7p. NTIS, PC A02/MF A01.

Self-absorption in electronic transition lasers can severely limit the efficiencies of such systems. We identified a bound-continuum X-A as well as possible bound-bound transitions which could absorb at the B-X lasing energy in Group II b-halides. Figure 1 shows the bound-continuum absorption transition for HgCl. Experimental evidence for these transitions is non-existent and ab initio calculations are required to obtain the spectroscopic properties of these systems. We can note parenthetically that the determination of the energies and spectroscopic properties of excimer and ion-pair type electronic transition lasers has relied heavily on ab initio calculation. A well-defined calculation scheme has been developed which is applicable over the entire periodic table. Relativistic - dependent pseudopotentials have been used in the calculation of the electronic structure and transition moments of HgCl. Compact but accurate bases have been determined variationally at the double zeta plus polarization level. The final wave functions, energies, and properties have been obtained at the first-order configuration interaction level of accuracy. Because pseudopotentials are used, the paraphanelia of computing the wavefunctions such as trial inputs and configuration interaction formula tapes are identical for all Group II b-halides, which would permit straight-forward extension of the HgCl results.

37053 (AD-A—079613/6) **O2 (1 delta)-i atom kinetic studies. Interim report.** Heidner, R.F. III; Gardner, C.E. (Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab.). 8 Nov 1979. Contract F04701-79-C-0080. 41p. NTIS, PC A03/MF A01.

A discharge flow system has been used to refine kinetic rate measurements for the O2(1 sub delta) + I energy-pooling process and for the iodine-catalyzed removal of O2(1 sub delta). Particular attention was given the effects of I2-carrier gas (Ar) on the emission intensity of O2(1 sub delta) and O2(1 sub sigma). A heated I2 saturator and a saturator bypass technique were developed to minimize such effects. The data reported here indicate that processes proportional to (O2(I sub delta)) to the 2nd power are important at (O2(1 sub delta)) and (I) densities, which are appropriate for a cw O2(1 sub delta)-I atom transfer laser.

37054 (AD-A—079797/7) **Bibliography of Soviet laser developments, number 39, January - February 1979.** (Defense Intelligence Agency, Washington, DC (USA)). Nov 1979. 121p. NTIS, PC A06/MF A01.

This is the Soviet Laser Bibliography for January-February 1979 and is no. 39 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; beam-target interaction; and plasma generation and diagnostics.

37055 (AD-A—079879/3) **Shock induced starting of gasdynamic laser nozzles. Master's thesis.** Weber, P.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1977. 103p. NTIS, PC A06/MF A01.

Dynamic processes occurring in single and multiple arrays of contoured Mach 3.2 rapid expansion, two-dimensional, supersonic nozzles during the passage of strong shock waves were investigated. Two sizes of single throat nozzles were tested. Their throat openings were 0.276 and 0.069 inch. The multiple nozzle array used had nine parallel nozzles of the smaller size arranged to simulate the flow channel of a gas dynamic laser. Several series of schlieren photographs were taken of the flow field within the nozzles. A fully started condition evidenced by uniform supersonic flow was observed in the small single nozzle and the multiple throat array approximately 80 microseconds after the passage of Mach 2.33 shock waves. The large single nozzle was not fully started by Mach 3.0 incident shocks. The dynamic flow initiation process was found to be strongly influenced by the strength and frequency of transverse wave reflections in the nozzle inlets. The larger single nozzle's failure to start is believed to be due to the fact that its larger inlet size reduced the frequency of these reflections by an amount which prevented the rapid increase in effective reservoir pressure necessary for supersonic flow initiation. A novel digital time delay computer was designed and built to facilitate making closely spaced photographs of the flow patterns.

37056 (AD-A—079891/8) **Light distribution near the line focus in a HSURIA laser resonator. Interim report.** Carter, W.H. (Naval Research Lab., Washington, DC (USA)). 24 Dec 1979. 13p. NTIS, PC A02/MF A01.

The intensity distribution about the line focus inside a HSURIA resonator is obtained theoretically and used to study the gas break-down problem for high-energy lasers.

37057 (AD-A—079904/9) **Separation control in the all APT light pipe. Master's thesis.** Bailey, W.H. Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1979. 92p. NTIS, PC A05/MF A01.

An experiment was performed to determine separation regions inside a high energy laser (HEL) beam relay light pipe. The pipe is part of the beam relay system used in conjunction with the CO_2 Gas Dynamic Laser (GDL) system under development by the Air Force Weapons Laboratory. It was found that the air flowing through the pipe separated at the elbows. This separation can cause uneven radial heating attributed to molecular absorption. The self-induced thermal distortion of the beam can cause phase distortions degrading the beam. A study of separation control systems within the pipe was made. A full-scale axisymmetric model was studied on the water table. Areas of separation were found by flow visualization using dye injection. A brief evaluation of suction and blowing to control separation showed both of these methods acceptable. Separated regions discovered at each elbow on the water table were the focus of study for a full-scale air flow plexiglass model. The turbulent flow in the pipe was studied using smoke injection to reveal air motion in the pipe. Mass flow rates of air through the pipe were 1 lb/min and 8 lbs/min. Suction and blowing were assessed as flow separation control methods.

37058 (AD-A—079984/1) **Simultaneous SRS and SHG in lithium iodate. Final report May 78-May 79.** Ammann, E.O. (GTE

Sylvania, Inc., Mountain View, CA (USA)). Jul 1979. Contract F49620-78-C-0077. 64p. NTIS, PC A04/MF A01.

This report summarizes the results of a study of the simultaneous occurrence of stimulated Raman scattering (SRS), second-harmonic generation (SHG), and sum-frequency generation (SFG) in lithium iodate. The simultaneous occurrence of these processes in lithium iodate results in selectable, multiple outputs spanning the 0.54 to 0.65 micrometer region of the visible spectrum. The SRS/SHG/SFG device consists of a lithium iodate crystal placed inside a cw-pumped, repetitively Q-switched Nd:YAlO3 laser. Two-mirror and three-mirror versions of the SRS/SHG/SFG device were studied. The two-mirror SRS/SHG/SFG average power outputs that were achieved were 0.54 (1.13 W), 0.565 (78 mW), 0.592 (685 mW), 0.622 (98 mW), and 0.655 micrometers (107 mW). The three-mirror SRS/SHG/SFG outputs were 0.54 (950 mW), 0.565 (218 mW), 0.592 (202 mW), 0.622 (29 mW), and 0.655 micrometers (26 mW). Pulses obtained from the two-mirror setup were approximately 25 to 40 ns long; pulses obtained from the three-mirror setup were 4 to 10 ns long. Experimental and analytical studies were also carried out concerning interactions which occur between the simultaneous SRS, SHG, and SFG processes.

37059 (AD-A—080070/6) **Rotational population transfer in DF. Final report 1 Feb-30 Sep 79.** Hinchen, J.J.; Hobbs, R.H. (United Technologies Research Center, East Hartford, CT (USA)). 31 Dec 1979. Contract F49620-79-C-0032. 47p. NTIS, PC A03/MF A01.

Collisional transfer of population between rotational levels of DF was measured using an ir double resonance method. The data were used to calculate rotational rates. Pressure broadening of DF absorption was determined for the fundamental lines P6 through P18. Total molecular collisional rates were obtained from the absorption data and compared with the total of individual collisional rates for velocity, vibrational and rotational relaxation. The results were compared with two kinetic rate models. Observation were also made of rotational lasing and vibration to rotation transfer in DF.

37060 (AD-B—015026/8) **Three to five micron VET laser investigation. Final report 2 Jan-31 Dec 75.** Shirley, J.A. (United Technologies Research Center, East Hartford, CT (USA)). Sep 1976. Contract F33615-75-C-1047. 58p. NTIS, PC A04/MF A01.

The objective of this investigation is to develop and demonstrate the technology necessary to design a practical airborne molecular vibration-vibration energy transfer laser operating in the 3 to 5 micrometers spectral range with an output of 10-100 watts. The deuterium-donor/hydrogen chloride-acceptor system has been selected as the most promising transfer system in the given spectral region. Spectroscopic measurements have been made in flowing HCl vibrationally excited by transfer from deuterium excited in a self-sustained dc electric discharge. The medium is characterized by a vibrational temperature, which is T sub V = 1440-1960 K and rotational temperature, which is T sub V = 240-325 K immediately after mixing and transfer. Donor gas excitation determined by Raman scattering in the hydrogen isotope corresponds to T sub V = 900-1350 K. Calorimetric measurements of electric discharge heat losses have confirmed the relatively low level of discharge vibrational excitation. Attempts to determine post discharge dissociation have been negative.

37061 (AD-B—015176/1) **Solar pumped laser. Final technical report 18 Feb 74-11 Jul 75.** Taynai, J.D. (GTE Sylvania, Inc., Mountain View, CA (USA)). Sep 1976. Contract F33615-74-C-1062. 112p. NTIS, PC A06/MF A01.

The objective of the work described in this report was the demonstration and delivery of a modelocked, frequency doubled, conductively cooled, solar pumped laser, designed to prototype space qualifiable level and structurally compatible with the EFM lamp pumped laser developed under AF contract No. F33615-74-C-1028. The laser was required to provide a minimum of 250 mW of 0.53 micrometers radiation, mode locked at an average prf of 500 MHz with a pulse width of less than 300 ps. The laser actually produced 400 mW with 280 ps pulses with a Nd:Cr:YAG laser rod. Maximum power was 480 mW with 560 ps pulses.

37062 (AD-B—017604/0) **Laser pump lamp. Final technical report Dec 74-Oct 75.** Anderson, N.C. (ILC Technology, Inc., Sunnyvale, CA (USA)). Feb 1977. Contract F33615-75-C-1080. 60p. NTIS, PC A04/MF A01.

A program was conducted to continue development of a potassium-rubidium arc lamp for laser pumping. The average useful lifetime of such lamps was significantly increased, primarily as the result of improved lamp end seal technology. Life-times of nickel and Kovar endcap lamps built at the end of the program were typically in the 600-1000 hour range. The primary lamp failure mode was basal plane cleavage cracking of the sapphire envelopes. Difficulty in obtaining good CVD niobium-to-sapphire seal assemblies from outside suppliers hampered development work on the alternative protected end seal lamp design. One lamp was life tested, failing at 182 hours. Experiments on laser pumping efficiency were conducted. Efficiency was found to be roughly proportional to the potassium:rubidium ratio in the lamp fill. Four millimeter bore lamps were found to be more efficient than standard five millimeter bore lamps.

37063 (AD-B—020481/8) **Long life ND:YAG laser device. Final report 17 Mar 75-18 Mar 76.** Huchital, D.A. (Perkin-Elmer Corp., Norwalk, CT (USA)). May 1977. Contract F33615-75-C-1193. 69p. NTIS, PC A04/MF A01.

The developed electrodeless lamp is compatible with conductive cooling. It has been demonstrated that the life of such a lamp has been greater than 1000 hours of operation. Furthermore, it has been demonstrated that an output of one watt multimode at 1.06 micron can be achieved for an input of 215 watts of RF power to the lamp.

37064 (AD-B—023873/3) **Hydroxyl radical chemical laser. Final report 2 Jul 75-2 Feb 77.** Daiber, J.W.; Raymonda, J.W.; Thompson, H.M. (Calspan Corp., Buffalo, NY (USA)). Nov 1977. Contract N00123-75-C-0685. 32p. NTIS, PC A03/MF A01.

The reaction of H-atoms with O3 is known to result in the product molecule OH being in the ninth vibrational level. Such a high level of chemiexcitation could result in chemical laser action. The motivation for developing such a laser is (1) the wavelength at which lasing would occur has good atmospheric transmission, and (2) the reactants and products can be handled safely. In the present program, techniques were developed for generating large fluxes of H-atoms and O3-molecules. An apparatus was constructed for the demonstration of lasing; however, full testing could not be completed in this program. Lasing was not achieved.

37065 (KMSF-U—937) **FEL amplifiers for fusion systems.** Segall, S.B. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 4p. (CONF-800208—18). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

Free electron laser systems for fusion are described. Basic design features of amplifiers which reduce energy spread and adjust to variations of laser intensity in multipass laser configurations with recirculating electron beams are explained.

37066 (KMSF-U—955) **Chroma I Nd:glass laser performance at ir and green.** Thomas, C.E.; Moncur, N.K.; Masters, F.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 4p. (CONF-800208—20). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

The KMS two-beam Nd:glass lser system has been upgraded to the 2 TW level. Performance of this 14 cm phosphate glass system is described at 1.054 μm and at the frequency doubled green line (.527 μm).

37067 (UCID—18791) **Optical alignment device for aligning an external laser to an arbitrary axis.** Murray, J.E.; Jones, W.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

An alignment device to simplify the alignment of an external laser to an arbitrary axis was constructed. It provides independent adjustments for the four required beam motions: two orthogonal translations and two orthogonal rotations about an external point.

37068 **Optically pumped NSF molecular laser.** Fischer, T.A.; Tiee, J.J.; Wittig, C. (Department of Electrical Engineering, University of Southern California, University Park, Los Angeles California 90007). *Appl. Phys. Lett.;* **37**: No. 7, 592-594(1 Oct 1980).

An optically pumped NSF laser, with tunable output in the region 618—658 cm^{-1}, and pumped with a tunable transversely excited atmosphere (TEA) CO_2 laser, is described. This laser promises to be an attractive source for laser isotope separation.

37069 **Trapped particle dynamics and efficiency optimization in free electron lasers.** Kwan, T.J.T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **23**: No. 9, 1857-1861(Sep 1980).

The dynamics of trapped particles in free electron lasers has been investigated. From the results of computer simulations, it is found that the efficiency of energy extraction from the electron beam maximizes at a particular initial intensity of the electromagnetic radiation. Based on the physical argument of the dynamics of trapped particles, a criterion which accurately predicts the optimum intensity of the electromagnetic radiation has been obtained.

37070 **Recent pulse width and linewidth measurements on the mode-locked Kr^+-ion laser.** Steinmetz, L.L.; Bookless, W.A.; Richardson, J.H. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Appl. Opt.;* **19**: No. 16, 2663-2665(15 Aug 1980).

The output power of six lines is studied for Spectra-Physics Kr^+-ion lasers models 171k. (AIP)

37071 Metal vapor laser . Ogata, Y. (to Matsushita Electronics Corp (Japan)). US Patent 4,210,876. 1 Jul 1980. Priority date 13 Dec 1976, Japan, vpp.

A description is given of a metal vapor laser discharge tube comprising: an anode, a cathode, a laser capillary, a metal reservoir disposed at one end of said laser capillary between said anode and said laser capillary, an air-tight envelope enclosing said cathode and said laser capillary, and a condenser coaxial with said laser capillary and said cathode disposed in a discharge path between said laser capillary and said cathode for condensing metal vapor, said discharge path being formed inside said condenser.

37072 Split ground state atomic iodine or bromine laser . Pleasance, L.; Riedel, E.; Weaver, L. (to Westinghouse Electric Corp). US Patent 4,210,877. 1 Jul 1980. Filed date 24 Jul 1978. vpp.

A description is given of laser apparatus comprising: an enclosure; a gas in said enclosure comprising an inert buffer gas and an active gas having the formula C/sub n/Y/sub 2n+1X/, wherein Y is H or F, X is either I or Br and N is 1, 2, 3 or 4; spaced apart electrode means defining a volume discharge region therebetween; means for producing a flow of said gas through said volume discharge region; means for excitig said gas by producing electrons to colide with the molecules of said active gas to produce electrically excited atomic iodine or bromine; said means for exciting gas including; (1) means for providing free electrons to the volume discharge region both prior to and during a volumetric electrical discharge; and (2) pulse dc excitation means operably conected to said spaced apart electrodes to produce a volumetric electrical discharge across said electrode to excite said gas; and means for producing stimulated emission of radiation from said gas.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 37043, 37044, 37045

37073 (AD-A—079642/5) **The formulation of selected free boundary problems as conservation laws.** Rogers, J.C.W. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Dec 1979. Contract N00014-79-RC-90009. 15p. NTIS, PC A02/MF A01.

Some free boundary problems are written as conservation laws. Numerical algorithms conserving the necessary quantities are discussed. Suitable function spaces are mentioned. Formal extensions of the algorithms to systems are proposed. Analytic difficulties in the solution of systems in higher spatial dimensions are suggested.

37074 (SAND—79-2377C) **Numerical study of natural convection in a horizontal porous layer subjected to an end-to-end temperature difference.** Hickox, C.E.; Gartling, D.K. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 31p. (CONF-801102—2). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A numerical study of steady, natural convection in a fluid-saturated, horizontal, porous layer subjected to an end-to-end temperature difference is reported. The analysis is performed using a finite element computer program based on the Galerkin form of the finite element method. Heat transfer rates are predicted for aspect ratios ranging from 0.1 to 0.5 and Rayleigh numbers in the range 25 to 200. Representative plots of temperature and velocity fields are presented. Comparisons are made with an approximate analytical solution and regions of validity are identified for the analytical solution.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 36672

VACUUM ENGINEERING

37075 (BNL—28268) **Interrupted pumpdown of a vacuum system.** Edwards, D. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-801037—8). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

The pressure rise due to a surface outgassing process following a real pump closure has been analyzed and found under a physically reasonable parameter selection to occur very quickly yet result in a very slight actual pressure change. Real leaks thus should be able to be able to be distinguished from surface outgassing processes by this technique.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 36630, 36637

37076 (JPRS—76060) **USSR report: electronics and electrical engineering, No. 68.** 17 Jul 1980. Translation of various papers. 85p. NTIS.

Articles, abstracts, and news items published in the USSR on electronic materials, components and devices, on circuit theory, pulse techniques, electromagnetic wave propagation, radar, quantum, on electronic theory, development and devices, and on electric power machinery and transmission are presented.

37077 (JPRS—76064) **USSR report: electronics and electrical engineering, No. 69.** 17 Jul 1980. Translation of various papers. 56p. NTIS.

Articles, abstracts, and news items published in the USSR on electronic materials, components and devices, on circuit theory, pulse techniques, electromagnetic wave propagation, radar, quantum, on electronic theory, development and devices, and on electric power machinery and transmission are presented.

WASTE PROCESSING PLANTS AND EQUIPMENT

37078 (EPA-CI—77-0198) **Integrated energy systems monitoring municipal wastewater treatment plant, Wilton, Maine.** Fuller, D.F.; Lisa, A.J.; Wilke, D.A.; Thomas, P.L. (Wright-Pierce, Topsham, ME (USA)). May 1980. 131p. NTIS, PC A07/MF A01.

A project was initiated to monitor the performance of several alternative energy systems installed in the municipal waste water treatment plant in Wilton, Maine. These systems include: active and passive solar, effluent heat recovery, digester gas generation, air-to-air heat recovery, and electricity generation using digester gas. The plant has been operational since September of 1978. To accomplish the monitoring, an instrumentation system has been installed and data collected since the end of May 1979. This instrumentation system includes: solar pyronometers, hydronic Btu computers, electrical and gas meters, a weather station, and numerous temperature transmitters. Data for the solar and digester systems are available in both digital and analog forms. This report is based on data collected from June 1, 1979 to April 1, 1980 with digester gas production monitoring available during a two-week period in April. Specific data are summarized for information on solar insolation; active and passive solar systems; the effluent heat pump; the generator heat recovery system; digester gas system; and exhaust air heat recovery. The evaluation of the performance of the various energy systems in Wilton, their construction and operating costs, and evaluation of the relative cost-effectiveness of the Wilton design applied to other waste water treatment facilities of various capabilities has led to the formulation of a hypothesis whic, although not conclusively proven through this work, has much evidence to support it. That is, that solar thermal energy collection combined with anaerobic sludge digestion for the purpose of producing a net excess of digester gas be used as a fuel is not cost-effective, regardless of size or location of the facility.

37079 Method of operation for a refuse incinerating furnace . Melan, C.; Weiwers, R. US Patent 4,210,087. 1 Jul 1980. Priority date 1 Jul 1977, Luxembourg, vpp.

A description is given of a method of operating a pyrolysis furnace of the descending column type for incinerating refuse, notably household refuse, commercial and industrial rubbish, of the type comprising a charging zone, a drying zone, a pyrolysis zone and a combustion and melting zone, having at least one orifice for extracting volatile products from the drying zone, at least one orifice for extracting melted slag from the combustion and melting zone, and one or more tuyeres for injecting combustion gases under pressure into the combustion and melting zone, the improvement comprising injecting the combustion gases into the liquid mass of molten slag thereby controlling and diminishing the energy liberated at the level of the combustion and melting zone by the injection of said gases under pressure so as to prevent channel formation.

37080 Twin air classifier system . Olson, S.; Paterson, M.; Paxson, W. (to Raytheon Co). US Patent 4,210,527. 1 Jul 1980. Filed date 12 Apr 1979. vpp.

Resource recovery apparatus comprising the combination of a plenum having two separate materials-receiving chambers in its upper region and a materials-collection chamber in its lower region in direct communication with both of said receiving chambers, a pair of inclined rotary drum classifiers having their upper ends operatively connected with respective receiving chambers, and means for creating air streams through the drums and the respective receiving chambers, said drums being rotatable whereby materials deposited in the drums will be separated therein into heavy components which

exit from the lower ends of the drums and light components which are D R A W I N G removed by the air streams into the respective receiving compartments and deposited in the common collection chamber.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 35864, 35908, 35982, 37079

37081 (ANL/CEN/FE—79-14) **Support studies in fluidized-bed combustion. Annual report, October 1978-September 1979.** Johnson, I.; Myles, K.M.; Swift, W.M. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 85p. NTIS, PC A05/MF A01.

This work supports the development studies for atmospheric and pressurized fluidized-bed coal combustion. Laboratory and process development studies are aimed at providing needed information on limestone utilization, removal of particulates and alkali metal compounds from the flue gas, control of SO_2 and trace pollutant emissions, the mechanism of attrition in fluidized-beds, a method of determining the attrition resistance of sorbents, and other aspects of fluidized-bed coal combustion.

37082 (DOE/ET/15457—8) **Long term materials test program. Preliminary operations plan.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Mar 1980. Contract AC01-79ET15457. 97p. NTIS, PC A05/MF A01.

The Long Term Materials Testing (LTMT) PFB facility has been designed to duplicate the design point condition of the Coal-Fired Combined Cycle (CFCC) reference commercial plant design developed by GE under contract to DOE, including bed temperature (1750°F), pressure (10 atm), excess air (20%), and gas residence time (1.8 sec). The test rig has a one foot diameter bed and consumes about 1.6 tons/day of coal and 0.5 tons/day of dolomite sulphur sorbent. Material specimens are contained in two test sections. The low velocity test section houses 132 pin specimens 1/4 dia., sixty of which can be cooled below the gas stream temperature. The nominal exposure environment of 1650°F, 10 atm, 27 fps should ensure representative corrosive conditions, without erosion. The control system for the LTMT facility is designed to operate the rig in such a manner that the test specimens are subjected to constant, controlled conditions representative of the actual service environment. The Preliminary Test Plan presented in Section V outlines three phases of PFB testing, plus screening tests for candidate materials. Operating costs have been updated to reflect the preliminary rig design data and current raw material quotes. The projected operating costs have been effected by raw material costs since the time of the original estimate, but the overall cost per hour of test is still very low: $122/ test hour.

37083 (DOE/PE—03871-01, pp 11.1-11.16) **Fluidized-bed combustion.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The operation, performance, economics, and environmental effects of conventional boilers with flue gas desulfurization are compared with those aspects of boilers using atmospheric pressurized fluidized-bed combustors. It is concluded that fluidized-bed combustors are technically practical, can be produced by existing boiler manufacturers, are cost competitive with conventional systems with scrubbers, are likely to be installed in the near future for the generation of process steam in industrial applications, and require more experimental data in order to answer questions about fluidized-bed combustor reliability, maintenance costs, adaptability to different coal types, and overall economic performance. (LCL)

37084 (ORNL/TM—7401) **State of the art of pressurized fluidized bed combustion systems.** Graves, R.L. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 95p. NTIS, PC A05/MF A01.

This report was prepared at the request of the Tennessee Valley Authority (TVA) to clarify the development status of the pressurized fluidized bed combustor (PFBC) and to place in perspective the problems which are yet to be solved before commercialization of the concept is practical. This report, in essence, supersedes the interim report published in 1979, Assessment of the State of the Art of Pressurized Fluidized Bed Combustion Systems. A brief overview of the PFBC concept is included citing potential advantages and disadvantages relative to atmospheric fluidized bed combustion (AFBC) and conventional pulverized coal plants. A survey of existing and developing PFBC experimental facilities is presented in some detail which includes the major accomplishments at the respective facilities. Recent data on plant emissions, turbine/gas cleanup systems, and overall efficiency are provided. Findings of several design studies are also discussed. The results of recent gas turbine and cascade tests have been encouraging although the full assessment of the accomplishments have not been made. The delay in construction of the Grimethorpe plant causes further delay in proof-testing full-size, rotating turbomachinery. Several parameters are recommended for further assessment in design studies including: (1) effect of turbine life on cost of power; and (2) effect of reduced gas turbine inlet temperature and pressure on cost of power.

37085 **Fluidized bed conserves energy at Kogap through direct firing.** Oswald, M.W. Coeur d'Alene, ID; Energy Products of Idaho (1979). 4p. (NP—25129).

The operation of two fluidized bed combustors used in an Oregon plywood producing plant for burning wood wastes to provide dryer heat and steam for a waste heat boiler is described. (LCL)

37086 **Fluidized-bed combustion.** Oswald, M.W. Coeur d'Alene, ID; Energy Products of Idaho (1979). 4p. (NP—25128).

Fluidized bed combustion is a very new process being applied in various industrial applications. The forest products industry has applied the fluidized bed concept of combustion to a number of applications. Energy Products of Idaho, from its formation in 1973, has designed, manufactured and installed fluidized bed combustion systems totaling approximately forty operating units throughout the United States and Canada under the Fluid Flame trademark. These systems range in size in a single cell from an energy output of approximately 12MM Btu/h to 120MM Btu/h with the combustion chamber ranging in size from approximately 7' dia to 22' dia. Uses of and new developments in fluidized bed combustion are discussed.

UNDERGROUND ENGINEERING

37087 **Vertical permeability determination: a simple approach.** Arifi, N.A. (Al Fateh Univ., Tripoli, Libya); Menzie, D.E. pp 11p, Paper D of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The formation of vertical permeability is often a dominant influence in reservoir recovery processes with vertical fluid flow such as water or gas coning, gravity drainage of high relief reservoirs, and displacement by water or gas in an anisotropic formation. The available methods of determining this parameter either involve elaborate procedures which are seldom performed or may be difficult or impossible to apply for some reason. Core measurements of vertical permeability do not necessarily represent effective in situ values. In the present study an analytical model has been used to study the transient flow behavior of wells with restricted fluid entry. Using computer calculations, a simple method is then presented that permits the engineer to determine easily the amount of vertical permeability. The paper presents a challenge for research specialists of well logging to make efforts for developing new techniques of estimating the vertical permeability. The present work can be considered as a possible correlation basis in this respect.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 36861

37088 **Emission-free valve** . Koppe, W.; Prummer, R. (to Herion Werke Ag (Germany, F.R.)). US Patent 4,210,167. 1 Jul 1980. Priority date 30 Jun 1977, German, Federal Republic of (F.R. Germany), vpp.

a description is given of an emission-free valve, particularly a magnetically operated valve, for use in controlling the flow of fluids, especially poisonous, radioactive, aggressive and otherwise dangerous gases and fluids, comprising a housing including a housing member which has substantially spherical configuration and an internal surface surrounding a compartment for the respective fluid, said housing further including an annular valve seat member; a valve member movably mounted in said compartment and cooperating with said valve seat member to control the flow of the fluid through said compartment; and a plating layer of a corrosion-resistant material covering said internal surface of said housing member and also having a substantially spherical configuration corresponding to that of said housing member, said housing member and said plating layer obtaining their respective configurations during an explosion which not only simultaneously deforms initially cylindrical tubular and coaxially arranged housing member and plating layer preforms, but also welds said plating layer preform to said housing member preform so that said platinglayer is explosion-welded to said housing member.

POWER CYCLES

REFER ALSO TO CITATION(S) 36459

RANKINE

37089 (DOE/PE—03871-01, pp 15.1-15.21) **Organic Rankine cycle engines.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The feasibility of using organic Rankine cycle (ORC) engines for on-site power generation is discussed in terms of engine design, operation and performance, economics, safety, organic working fluids characteristics and environmental effects. ORC engines are advantageous because they can use heat in the 200 to 600°F range. These temperatures can be obtained with solar collectors, geothermal sources, and waste heat streams. The status of commercial efforts to develop ORC engines is reviewed. It is concluded that ORC engine systems will be available on a commercial basis within 5 y over a range of system capacities from 3 kW to 1 MW. (LCL)

STIRLING

37090 (DOE/PE—03871-01, pp 14.1-14.28) **Stirling engine-powered energy systems.** Nov 1979.

In Distributed energy systems: a review of related technologies.

The design and development of Stirling engines for automotive propulsion and for stationary power sources are discussed in detail. (LCL)

OTHER

37091 **Solid state engine with alternating motion.** Golestaneh, A.A. (to Dept. of Energy). US Patent Application 113,868. 21 Jan 1980. 10p.

Heat energy is converted to mechanical motion utilizing apparatus including a cylinder, a piston having openings therein reciprocable in the cylinder, inlet and outlet ports for warm water at one end of the cylinder, inlet and outlet ports for cool water at the other end of the cylinder, gates movable with the piston and slidably engaging the cylinder wall to alternately open and close the warm and cool water ports, a spring bearing against the warm water side of the piston and a double helix of a thermal shape memory material attached to the cool end of the cylinder and to the piston. The piston is caused to reciprocate by alternately admitting cool water and warm water to the cylinder.

37092 **Solid state engine using nitinol memory alloy.** Golestaneh, A.A. (to Dept. of Energy). US Patent Application 114,134. 21 Jan 1980. 14p.

A device for converting heat energy to mechanical energy includes a reservoir of a hot fluid and a rotor assembly mounted thereabove so a portion of it dips into the hot fluid. The rotor assembly may include a shaft having four spokes extending radially outwardly therefrom at right angles to each other, a floating ring and four flexible elements composed of a thermal memory material having a critical temperature between the temperature of the hot fluid and that of the ambient atmosphere extending between the ends of the spokes and the floating ring. Preferably, the flexible elements are attached to the floating ring through curved leaf springs. Energetic shape recovery of the flexible elements in the hot fluid causes the rotor assembly to rotate.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 37442

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

37093 (UCID—18774) **Pulsing a charged particle beam by energy modulation and dispersive deflection.** Neil, V.K.; Paul, A.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 17 Sep 1980. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

A method for the production of a variable duty cycle pulsed electron beam is investigated theoretically. A longitudinally uniform beam is passed through an rf cavity that introduces energy modulation of the beam particles. The beam then enters a magnetic deflection array with dispersive properties that allow transmission of particles with momentum within a range selected by the position of a beam stop within the array. The transmitted portion of the beam exits the array along the same beam line with no angular or positional dispersion. For +- 1% momentum modulation the duty cycle of a 50 MeV electron beam with emittance 2.5π cm-mrad is adjustable from 27% to 100% of the rf period by varying the position of the stop.

AUXILIARIES AND COMPONENTS

REFER ALSO TO CITATION(S) 36932

EXPERIMENTAL FACILITIES AND EQUIPMENT

37094 (BNL—51222) **Phenomenological method of calculating microwave longitudinal coupling impedances.** Giordano, S.; Votruba, J. (Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 9p. NTIS, PC A02/MF A01.

A previous paper described an investigation of the longitudinal coupling impedance of the TM/sub olm/ modes in the ISA vacuum chamber. A method was developed for calculating these impedances by using the data derived from pertubation measurements. This method gave accurate results between 2.6 and 2.8 GHz, but above 2.8 GHz measurements became difficult because of the mixing of the TM/sub olm/ modes with other modes. This paper presents a phenomenological approach for calculating these impedances based on previously developed concepts.

37095 (LA—8505-MS) **High-voltage pulse monitor system for neutrino electron elastic scattering.** Dalton, C. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01.

The Neutrino Electron Elastic Scattering Experiment will use 40 high-voltage pulsers and 40 flash-chamber detector modules. This report describes the proposed microprocessor controlled monitor system to ensure the safe and efficient operation of the high-voltage pulsers and flash chambers.

37096 (SLAC-PUB—2549) **SLAC linear collider.** Richter, B.; Bell, R.A.; Brown, K.L. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 23p. (CONF-800740—20). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The SLAC LINEAR COLLIDER is designed to achieve an energy of 100 GeV in the electron-positron center-of-mass system by accelerating intense bunches of particles in the SLAC linac and transporting the electron and positron bunches in a special magnet system to a point where they are focused to a radius of about 2 microns and made to collide head on. The rationale for this new type of colliding beam system is discussed, the project is described, some of the novel accelerator physics issues involved are discussed, and some of the critical technical components are described.

STORAGE RINGS

37097 (BNL—28272) **Evaluation of ISABELLE full cell ultra high vacuum system.** Foerster, C.L.; Briggs, J.; Chou, T.S.; Stattel, P. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 30p. (CONF-801037—5). NTIS, PC A03/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

The ISABELLE Full Cell Vacuum System consisting of a 40 m long, by 8.8 cm diameter stainless steel tube pumped by seven pumping stations was assembled and processed for 10^{-12} Torr operation. Evaluation and testing of the system and its sub-assemblies has been completed. Detail design of system components and the determination of the conditioning process was completed. The best procedure to rough pump, leak test, vacuum bake the system, condition pumps, degas gauges, turn on ion pumps and flash sublimation pumps was established. Pressures below 2×10^{-11} Torr are now routinely achieved in normal operation of the Full Cell. This includes pump down after replacement of various components and pump down after back fill with moist unfiltered air. The techniques developed for the Full Cell will be used to build the ISABELLE Ultra High Vacuum System.

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 36951

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 36174, 36678, 37025, 37207

37098 (UCID—18775) **Electronics Engineering Research. Final report, FY 1979.** Weissenberger, S. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01.

Accomplishments in Electronics Engineering Research (EER) during FY79 spanned a broad range of technologies, from high-speed microelectronics to digital image enhancement; from underground probing with electromagnetic waves to detecting neutrons with a small solid-state device; and from computer systems to aid engineers, to software tools to aid programmers. This report describes the overall EER program and its objectives, summarizes progress made in FY79, and outlines plans for FY80.

37099 **Semiconductor radiation detector.** Kobayashi, T.; Matsuo, N.; Sugita, T. (to Tokyo Shibaura Electric Co Ltd (Japan)). US Patent 4,210,805. 1 Jul 1980. Priority date 17 Feb 1977, Japan, vpp.

A description is given of a semiconductor radiation comprising a detector unit including a detection element having a single crystal silicon substrate with an impurity concentration of less than 1 X 10^{14} cm^{-3}, a metal layer formed on one surface of the substrate to provide a surface barrier between the metla layer and the substrate, the surface barrier having a rectifying characteristic, and an electrode layer formed on the other surface of the substrate, and an output circuit connected to the metal layer and electrode layer of the detectin element to obtain an output corresponding to an amount of x-ray or gamma ray radiation incident on the detector unit without the application of a bias across the detection element.

RADIATION DOSEMETERS

37100 **Dosimeter for measuring skin dose and more deeply penetrating radiation.** Jones, D.E.; Parker, D.; Boren, P.A. (to Dept. of Energy). US Patent Application 055,211. 6 Jul 1979. 20p.

A personnel dosimeter includes a plurality of compartments containing thermoluminescent dosimeter phosphors for registering radiation dose absorbed in the wearer's sensitive skin layer and for registering more deeply penetrating radiation. Two of the phosphor compartments communicate with thin windows of different thicknesses to obtain a ratio of shallowly penetrating radiation, e.g. beta. A third phosphor is disposed within a compartment communicating with a window of substantially greater thickness than the windows of the first two compartments for estimating the more deeply penetrating radiation dose. By selecting certain phosphors that are insensitive to neutrons and by loading the holder material with neutron-absorbing elements, energetic neutron dose can be estimated separately from other radiation doses. invention also involves a method of injection molding of dosimeter holders with thin windows of consistent thickness at the corresponding compartments of different holders. This is achieved through use of a die insert having the thin window of precision thickness in place prior to the injection molding step.

37101 (PNL-SA—8753) **Experimental considerations for the calibration of personnel dosimeters with photons.** Hooker, C.D.; Yoder, R.C.; Courtney, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract AC06-76RL01830. 4p. NTIS, PC A02/MF A01.

The criteria for irradiating radiation dosimeters for test purposes are defined quite clearly in Draft ANSI Standard N13.11. In this Draft the use of phantoms, constructed of a near tissue equivalent material, is prescribed for backing the dosimeters while being irradiated, thus simulating a dosimeter being irradiated while attached to a person. When the phantom is placed in the photon beam it becomes a major source of scattered radiation. The scatter component into the dosimeter is a function of the energy of the photon beam and must be defined for each effective energy used. In addition, it is usually cost effective to irradiate more than one dosimeter at the same time, which may result in mutual interference from the dosimeters themselves. The effects of these parameters upon a centrally positioned dosimeter in the presence of a phantom are studied.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

37102 **Rate dependence of counting losses in neutron time-of-flight measurements.** Moore, M.S. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Instrum. Methods;* **169**: No. 1, 245-247(Feb 1980).

A simple analytic correction is derived to permit correction for the rate dependence of counting losses in neutron time-of-flight measurements. The correction requires that the relative variance of the intensity be monitored during the experiment.

37103 **Arsenic activation neutron detector.** Jacobs, E.L. (to Dept. of Energy). US Patent Application 115,867. 28 Jan 1980. 14p.

A detector of bursts of neutrons from a deuterium-deuteron reaction includes a quantity of arsenic adjacent a gamma detector such as a scintillator and photomultiplier tube. The arsenic is activated by the 2.5-MeV neutrons to release gamma radiation which is detected to give a quantitative representation of detected neutrons.

37104 **Automatic sample changer for alpha spectroscopy with a surface barrier detector.** Hodgson, L.M.; Brown, D.A. (Arkansas Univ., Fayetteville (USA). Dept. of Agronomy). *J. Radioanal. Chem.;* **54**: No. 1-2, 211-220(1979).

Semiconductor particle detectors are ideal for alpha spectroscopy due to their compact size, low noise, and high resolution. This paper describes the construction and testing of an automatic sample changer for use with such a detector. The changer was constructed from locally available services and materials. It holds up to 24 samples of alpha emitting material deposited on 22 mm stainless steel counting planchets. The vacuum chamber can be evacuated to less than 10 μm mercury in 10 to 15 minutes. Once the chamber has been evacuated and detector bias has been applied, any sample in the chamber may be selected for analysis, either automatically or manually. Continuous automatic analysis of up to 24 samples is possible. Variation in efficiency from position to position was found to be 3.25% at the detector-sample spacing of 4.8 mm, and 2.31% at 27 mm. Shielding between the adjacent samples not under analysis and the detector was acceptable.

HIGH ENERGY PHYSICS INSTRUMENTATION

37105 (BNL—28195) **Optical fibers and avalanche photodiodes for scintillator counters.** Borenstein, S.R.; Palmer, R.B.; Strand, R.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 27p. (CONF-800684—7). NTIS, PC A03/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

Fine hodoscopes can be made of new scintillating optical fibers and one half inch end-on PMT's. An avalanche photodiode with small size and immunity to magnetic fields remains as a tempting new device to be proven as a photodetector for the fibers.

37106 (BNL—28279) **Microchannel plate as a detector of minimum ionizing particle.** Oba, K.; Rehak, P.; Smith, S.D. (Brookhaven National Lab., Upton, NY (USA)). 3 Sep 1980. Contract AC02-76CH00016. 11p. (CONF-800976—1). NTIS, PC A02/MF A01.

From Meeting on miniaturization of high energy physics detectors; Pisa, Italy (18 Sep 1980).

Micro-channel plate multipliers have been used to detect the passage of relativistic charged particles. Measurements of the detection efficiency and pulse height response versus micro-channel plate gain are presented for one, two and three micro-channel plate arrays. The probability of detecting an avalanche on the detector anode per one channel of MCP crossed by the relativistic particle was calculated. Temporal response and time jitter were measured and are reported. The track images of beam particles crossing the detector are shown.

37107 (COO—3071-249) **New type of Cherenkov imaging detector.** Robinson, B. (Pennsylvania Univ., Philadelphia (USA)). May 1980. Contract AC02-76ER03071. 9p. (CONF-800684—5). NTIS, PC A02/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

An imaging Cherenkov counter is being developed to measure the velocities of several secondary particles simultaneously over wide ranges in γ (γ identical with E/m), $20 < \gamma < 100$, and in particle angles (200 mrad x 200 mrad per unit). This detector, called the ORCID (Optical Readout Cherenkov Imaging Detector) is distinguished from other CID's by its readout system, which uses a lens to refocus and reduce a mirror image onto an image intensifier. The image intensifier is in turn coupled to an optical CCD array. An ORCID is being developed for use in Fermilab experiment E-609, a hadron jet experiment, and may have other applications.

37108 **Improving the electric field uniformity in large hybrid focal plane detectors.** Shapira, D.; Bomar, P.L.; Ford, J.L.C. Jr.; Gomez del Campo, J.; Dennis, L.C. (Oak Ridge National Lab., TN (USA)). *Nucl. Instrum. Methods;* **169**: No. 1, 77-81(Feb 1980).

The characteristics of a large volume hybrid counter consisting of an ionization chamber with a multi-element anode are described. Modifications to the cathode structure have been made in order to reduce the edge effects due to non-uniformities in the electric field distribution arising from the increased cathode-anode separation. Typical measurements obtained with this detector are presented and indicate that the values for the ΔE and E resolutions are similar to those for smaller volume counters.

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 35905, 35906

37109 Method and apparatus for the non-invasive determination of the characteristics of a segmented fluid stream . Pelavin, M. (to Technicon Instruments Corp). US Patent 4,210,809. 1 Jul 1980. Filed date 16 Mar 1979. vpp.

In apparatus for the detection of the respective segments, and the respective segment interfaces, of a continuous fluid stream which comprises alternating fluid segments flowing in an optionally transparent conduit, said fluid segments having different radiation energy absorbance and/or refraction characteristics, the improvements comprising, radiation energy source means disposed without said conduit and operable to irradiate the same and said flowing fluid stream, radiation energy detecting means disposed without said conduit and operable to detect the radiation energy from said source means which is transmitted through said conduit and said flowing fluid stream, and to output a signal indicative thereof, and means to process said output signal to indicate said fluid segments and said segment interfaces respectively, wherein, said fluid segments comprise segments of liquids, and wherein the spectral content of said radiation energy is generally outside the radiation energy absorbance range of said liquids.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

37110 (AD-B—011702/8) **Study of radiation effects in bulk CMOS microcircuits, I21/LSI logic cells and optical couplers. Final report jan-dec 74.** Raymond, J.P.; Wong, T.Y.; Ashe, J.E.; Perkins, C.W. (Northrop Research and Technology Center, Hawthorne, CA (USA)). Jun 1975. Contract DNA001-73-C-0154. 196p. NTIS, PC A09/MF A01.

Results are presented on the study of radiation effects in bulk CMOS microcircuits, basic logic cells of developmental integrated-injection-logic (I2L) LSI, and optical couplers. Radiation effects considered include the permanent damage effects resulting from neutron displacement damage and total ionizing radiation dose. Transient photoresponse has been measured as a function of ionizing radiation pulse width. CMOS latch-up was investigated as induced by electrical pulsed overstress and/or pulsed ionizing radiation exposure. No significant synergistic effects were observed.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 35903, 35904, 35905, 35906, 37046, 37185, 37203, 37456

37111 (BNL—27919) **Proportional wire calorimeter for magnet pole tips.** Kraus, D.; Ludlam, T.; Renardy, J.; Willis, W.; Zurfluh, E. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 6p. (CONF-801103—2). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

A total absorption calorimeter is designed to have magnetic properties comparable to those of ordinary steel, and thus can be incorporated into the poles of a spectrometer magnet without compromising the field quality. A test device has been built which consists of an iron structure penetrated by a finegrain pattern of holes, each acting as a proportional tube such that 90% of the volume is occupied by iron. Measurements of the energy and space resolution of this device in a high energy beam will be presented.

37112 (CONF-800814—18) **Continuous realtime radioiodine monitor employing on-line methyl iodide conversion.** Fernandez, S.J.; Motes, B.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 11p. NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

An integrated ^{14}C, ^{129}I, and ^{85}Kr monitor was proposed by Fernandez, et al. that separates ^{129}I from ^{85}Kr by selective permeation across thin silicone rubber membranes. Subsequent studies of the permeation of CH_3I and I_2 through silicone rubber membranes demonstrated that I_2 transport across the membranes is too slow to be useful in a realtime monitor. Transport of methyl iodide, however, is rapid and gives a separation factor of greater than 100 from ^{85}Kr.

37113 (SAND—80-0891) **Two-stage nonrecursive filter/decimator.** Yoder, J.R.; Richard, B.D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01.

A two-stage digital filter/decimator has been designed and implemented to reduce the sampling rate associated with the long-term computer storage of certain digital waveforms. This report describes the design selection and implementation process and serves as documentation for the system actually installed. A filter design with finite-impulse response (nonrecursive) was chosen for implementation via direct convolution. A newly-developed system-test statistic validates the system under different computer-operating environments.

37114 (SAND—80-1793C) **Characterization of Sandia Laboratories expanded linear array silicon gate CMOS standard cells.** Antinone, R.J.; Alexander, D.R.; Brown, G.W. (BDM Corp., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 20p. (CONF-801108—3). NTIS, PC A02/MF A01.

From Government microcircuit applications conference; Houston, TX, USA (19 Nov 1980).

Sandia National Laboratories has developed a family of standard cells based on radiation hardened silicon gate CMOS devices using 4 μm channel lengths. Because of their arrangement in regular linear patterns, the cells are referred to as expanded linear array (ELA) cells. Other papers submitted to this conference describe the design features of this cell family. This paper describes a systematic approach to the prediction of ELA cell operational characteristics. These characteristics include risetime, faltime, propagation delay, and maximum operating frequency as a function of load capacitance, transistor performance, and supply voltage. Data for these predictions are derived from device and process measurements and from geometrical data taken from mask plots.

37115 (SAND—80-1815C) **Intrusion detection system elements.** Eaton, M.J.; Mangan, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 28p. (CONF-801026—3). NTIS, PC A03/MF A01.

From ANS workshop on power plant security; Chicago, IL, USA (5 Oct 1980).

This report highlights elements required for an intrusion detection system and discusses problems which can be encountered in attempting to make the elements effective. Topics discussed include: sensors, both for exterior detection and interior detection; alarm assessment systems, with the discussion focused on video assessment; and alarm reporting systems, including alarm communication systems and dislay/console considerations. Guidance on careful planning and design of a new or to-be-improved system is presented.

37116 Quantitative surface topography determination by Nomarski reflection microscopy. 2: Microscope modification, calibration, and planar sample experiments. Hartman, J.S.; Gordon, R.L.; Lessor, D.L. (Pacific Northwest Laboratory, Richland, Washington 99352). DE-AC06-76RLO-1830. *Appl. Opt.;* **19**: No. 17, 2998-3009(1 Sep 1980).

The application of reflective Nomarski differential interference contrast microscopy for the determination of quantitative sample topography data is presented. The discussion includes a review of key theoretical results presented previously plus the experimental implementation of the concepts using a commercial Nomarski microscope. The experimental work included the modification and characterization of a commercial microscope to allow its use for obtaining quantitative sample topography data. System usage for the measurement of slopes on flat planar samples is also discussed. The discussion has been designed to provide the theoretical basis, a physical insight, and a cookbook procedure for implementation to allow these results to be of value to both those interested in the microscope theory and its practical usage in the metallography laboratory.

37117 Sensitive photothermal deflection technique for measuring absorption in optically thin media. Boccara, A.C.; Fournier, D.; Jackson, W.; Amer, N.M. (Laboratoire d'Optique Physique, E.R. 5 du CNRS, Ecole Superieure de Physique et de Chimie Industriells, 10, rue Vauquelin, 75231 Paris, Cedex 05, France). *Opt. Lett.;* **5**: No. 9, 377-379(Sep 1980).

A highly sensitive and simple photothermal scheme for determining optical absorptions in condensed-matter samples is presented. αl values as low as 10^{-7} and 10^{-8} were measured for thin films and coatings and for liquids, respectively. A comparison with the thermal lens effect is given, and the experimental factors limiting our sensitivity are discussed.

37118 (SAND—80-6018) **Method and vessel for carrying out metallothermic reactions, in particular aluminothermic reductions.** Teague, B. (Sandia Labs., Albuquerque, NM (USA)). 22 Jul 1980. Translation of German Patent 1,032,936. 13p. NTIS, PC A02/MF A01.

A method for carrying out metallothermic (aluminothermic) reactions in a refractory-lined, crucible-shaped reduction vessel is described. At the conclusion of the reduction reaction, the liquid slag is withdrawn by a lip in a horizontally divided vessel. (FS)

37119 Counterbalanced pushrod vacuum dilatometer for low-strength materials. Rose, R.L. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Phys., E (London);* **12**: 13-14(1979).

We have developed an accurate, counterbalanced, vertical-pushrod, vacuum dilatometer constructed primarily of brass, with a sampling force that can be reduced to less than 0.5 g. A special measuring loop confines distortion to quartz parts making sample measurement easier. Using this dilatometer we have reproduced the expansion characteristics of an Fe standard of the National Bureau of Standards to +- 0.5% in length up to a temperature of 1473°K. The measurement loop in the instrument is designed to include a quartz tube and pushrod, and a linear variable differential transformer.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 35941, 35984, 36039, 36041, 36042, 36045

37120 (SAND—80-1190C) **High temperature performance of MOS technologies.** Draper, B.L.; McBrayer, J.D.; Prince, J.L.; Fitch, L.T. (Sandia National Labs., Albuquerque, NM (USA); Clemson Univ., SC (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-800108—2). NTIS, PC A02/MF A01.

From SYSTEMS User's Group general meeting; New Orleans, LA, USA (29 Jan 1980).

Information is given which should make more versatile high temperature circuit design possible through the introduction of MOS components. Basic design guidelines and experimental results are presented which show that CMOS ICs can function at extremely high temperatures.

37121 Acoustic well logging method and apparatus for detecting and measuring an acoustic wave . Ingram, J. (to Schlumberger Technology Corp). US Patent 4,210,965. 1 Jul 1980. Filed date 27 Jul 1978. vpp.

A description is given of a method for automatically determining the location of an acoustic wave in a waveform which is representative of the output of a sonic receiver during well logging comprising the steps of scanning the waveform to form a gauge value indicative of maximum amplitude of the waveform; selecting a predetermined portion of the gauge value to establish a threshold value; forming combinations of initial portions of the waveform; and comparing the combinations with the threshold value to identify the place where the waveform exceeds the threshold as the location of the acoustic wave.

37122 Method and apparatus for determining acoustic wave parameters in well logging . Ingram, J. (to Schlumberger Technology Corp). US Patent 4,210,967. 1 Jul 1980. Filed date 27 Jul 1978. vpp.

An automatic sonic borehole investigating method operating with sonic waveforms derived from a plurality of sonic receivers which are vertically disposed in a predetermined manner in a borehole to respond to sonic waves introduced to propagate through an acoustic responsive medium by a transmitter located at preselected distances from the receivers comprising the steps of producing waveforms individually representative of sonic waves incident upon respective different receivers; estimating the arrival time of a predetermined signal in the different waveforms; combining the different waveforms in correspondence with an alignment of the estimated signal arrivals to form a signal emphasized waveform; and removing predetermined portions of the signal emphasized waveform from respectively associated waveforms to produce waveforms from which the predetermined signal is effectively filtered.

37123 Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979). 259p. (CONF-790605—(Vol.1)). $24.00 (per 2 Vol. set).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Twenty-six papers are included in this volume. Separate abstracts were prepared for 24 of these papers; the remaining two papers were previously abstracted. (DLC)

37124 Theory of log interpretation. Zverev, G.N. (All-Union Research Inst. of Oil Field Geophysics, Ufa, USSR). pp 31p, Paper C of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The improvement in quality of log interpretation is related to the development of the following trends: foundation of log interpretation theory and optimization of processing methods; automatic interpretation; involving additional geological and geophysical data concerning section and region in the processing procedure.

37125 Some theoretical aspects of how to correlate well log-evaluated data to core-determined reservoir properties. Zoltan, B. (Al-Fateh Univ., Tripoli, Libya). pp 20p, Paper E of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Simple and sophisticated physical-mathematical models are applied in well log evaluation to determine reservoir properties from well logs. The paper shows some modern theoretical aspects of how to correlate well logging data to core data. Some important items of interest are discussed, as follows: the proper concept of averaging (smoothing) the core data in heterogeneous formations, based on the vertical response (filtering) characteristic of the well logging borehole devices; the depth correlation between the two kinds of information; and the statistical optimization of interpretive formulae used in the quantitative analysis of well logs, in two different cases, when the core data are continuous, or, discontinuous, respectively, along the depth axis through the formation.

37126 Use of interlog relationships for geological and geophysical evaluations. McCoy, R.L.; Smith, R.F. pp 11p, Paper G of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Resistivities provide values from which pseudo-density and pseudo-velocity algorithms can be derived to use when one or both of the actual logs are missing for a critical well. This makes it possible to eliminate a density-derived velocity or a sonic-derived density for modeling a product of the two. In order to produce useful algorithms, a knowledge of the relationship of the measured parameters to those being reconstructed is necessary. If profiles of log values versus depth are prepared for wells having data, they can be used to verify derived equations. Profiles are also useful for extending rock properties horizontally and vertically into a cross section. Editing of log data is a prior function to any of the above operations, after which results from the above can be incorporated into the editing procedure.

37127 Radioactive logging parameters for common minerals. Edmundson, H.; Raymer, L.L. (Schlumberger-Doll Research Center, Ridgefield, CT). pp 20p, Paper O of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

This paper presents a list of about seventy minerals encountered in sedimentary formations together with their associated radioactive logging parameters. A procedure to calculate the radioactive parameters is given, and exact details are furnished for all logs but the neutron, which requires extensive and complex computation. Without considering rare elements such as boron, the computed neutron porosities assuming a thermal detecting device are consistently higher in shales, micas and zeolites than with an epithermal detecting device. This confirms experience in the field.

37128 Controlled environment for measurements in multiphase vertical flow. Cmelik, H. (GO Wireline Services, Ft. Worth, TX). pp 10p, Paper R of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

When data obtained from a recently developed string of small diameter production logging tools was compared to holdup and slip velocity values reported by other investigators, considerable discrepancies were noticed. From experiments conducted in short transparent pipe sections it was determined that the observed discrepancies are due to fluid holdup differences within the flow crossection. Although this had been suggested in some earlier work, the emphasis in previous investigations was put on the measurements of pressure gradients, from which light and heavy phase holdup and slip velocities were determined. To investigate holdup and fluid velocities particularly in the center of a vertical pipe, a flow test lab was built by GO Wireline Services in Fort Worth, Texas. The installation has three phase flow capabilities through a vertical section of up to 200 feet. The internal flow diameter can be varied from two to six inches. In addition a 30 foot section on top of the string can be inclined to an angle of up to 70 degrees from vertical. Surface meters permit accurate monitoring of each individual fluid flow rate, while five parameters are measured by the logging tools in the center of the pipe. The downhole tools are connected to a normal logging line and continuous logs in both directions can be run over a section of up to 170 feet. This also permits the investigation of the extent of inflow and outflow zones in multiphase flow systems.

37129 Matrix and response characteristics for sonic, density and neutron. Wells, L.E. (Scientific Software Corp., Denver, CO);

Sanyal, S.K.; Mathews, M.A. pp 25p, Paper Z of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The search for energy and minerals in the last few years has led the log analyst to new geological settings with lithologies unfamiliar to him. The data on Matrix response characteristics for the sonic, density and neutron tools in these lithologies are sparce at best and scattered in various published and unpublished sources. A search of the petroleum, geophysical and related literature has been made and a computerized listing system developed to establish a matrix data information source for the Log Analyst without a large reference library. The listing is designed to readily accept additions, updating and verifications. Contributors of new data will receive updated listings.

37130 Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979). 191p. (CONF-790605—(Vol.2)). $24.00 (per 2 Vol. set).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Well logging for the hydrocarbon, geothermal, and uranium fields is the subject. Twenty-two papers and three abstracts are included in this volume. Separate abstracts were prepared for 19 of the papers; the remaining three papers were previously abstracted. (DLC)

37131 Spectral gamma-ray logging I: energy stabilization methods. Stromswold, D.C.; Kosanke, K.L. (Bendix Field Engineering Corp., Grand Junction, CO). pp 10p, Paper DD of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

When NaI(T1) detectors are used to gather information on both the number of gamma rays and their energies, it is possible to calculate concentrations of specific radioelements along the borehole. A reference peak of constant energy is usually introduced into the spectrum, either by a low energy gamma-ray isotopic source; an alpha particle isotopic source, or by a light emitting diode. Gamma-ray sources are the simplest to use but interfere with the natural spectrum through Compton scattering. Alpha-particle sources do not give Compton interference, but the light output in scintillators is different for gamma rays and alphas as a function of temperature. Sources of ^{241}Am in small chips of NaI(T1), CsI(T1) and CsI(Na) were investigated as stabilization sources for NaI(T1). The temperature dependence of ^{241}Am in NaI(T1) was found to be at least four times greater than that of ^{241}Am in both CsI(T1) and CsI(Na) whose equivalent gamma-ray energies varied by 2 to 3% over the temperature range 30 to 120°F. A light emitting diode implanted in a NaI(T1) crystal provided an acceptable energy reference which varied by less than 1% when its electronic pulsing network was compensated for temperature dependence by a thermally reactive feedback network. The light from the diode did not interfere with the gamma-ray spectrum, but the complexity of the probe was increased by the pulsing network for the diode.

37132 Borehole geophysics in igneous and metamorphic rocks. Keys, W.S. (Geological Survey, Denver, CO). pp 26p, Paper OO of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Activities in geothermal energy, radioactive and industrial waste disposal, mineral exploration, engineering geology, and lunar and deep crustal exploration have increased the need for borehole geophysics in igneous and metamorphic rocks. Because there is a lack of knowledge and experience in the application of borehole geophysics to these rocks, the US Geological Survey is conducting research in this area. Igneous and metamorphic rocks usually present different petrophysical properties, such as porosity, density, resistivity, and mineralogy, than do sedimentary rocks. For this reason all conventional geophysical logging techniques may not be useful and petrophysics must be used to develop appropriate methods of log analysis. Core analyses plotted against log response and crossplotting of various logs in the computer are particularly useful for identifying the various rock types in an igeneous complex. Hydrothermal alteration and fluid movement through fractures are very important parameters that are needed from logs. Hydrothermal alternation may be recognized on well logs through the use of crossplots and borehole gamma spectrometry. The acoustic televiewer supported by other logs has been highly successful for identifying fractures that are transmitting either hot or cold water. 21 figures.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

37133 (AD-A—079942/9) Soil strain measurements on MISERS BLUFF. Phase II. Topical report 1 May 78-30 Apr 79. Shunk, R.A. (Electromechanical Systems of New Mexico, Inc., Albuquerque (USA)). 30 Apr 1979. Contract DNA001-78-C-0260. 43p. NTIS, PC A03/MF A01.

Soil strain measurements were made on the MISERS BLUFF - Phase II tests. The first test, a 109 metric ton ANFO explosion, indicated that the tubular, telescoping strain gage with large end plates and a DC LVDT sensing element should be adequate to measure strains on the second test which was the detonation of six 109 metric ton ANFO charges on the corners of a 100 m hexagon. The strains observed on the second event were much larger than on the first event. Three locations were instrumental to 1.6 m in depth for vertical strain, two halfway between charges on opposite sides of the array and one 6 m from the array center. The strains were initially compressive due to air shock loading and then extensional during the negative phase. Extensional strains greater than 50% were observed at the 6 m location down to a depth of 0.9 m. The air shock loading at the locations between charges was not the same, nor were the soils identical. Strains of -12% to +30% were typical at near surface locations. The final or residual strain measured on recovery was usually compressive except at one location where the soil was very powdery.

37134 (LA—8332) Thermal response of spherical explosive charges subjected to external heating. Jaeger, D.L. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

A series of one-dimensional heating experiments was performed with selected high explosives (HEs) in unconfined spherical geometries. The purpose of the program was to observe experimentally the thermal behavior of HE specimens near their ignition temperature and also to examine the accuracy with which the Arrenius kinetics models can simulate the ignition process. All test samples were instrumented with thermocouples and the time-temperature data were recorded on a flexible disk. Comparisons between analytical predictions and test data show that (1) the explosives go through a solid-state induction process before the Arrhenius models describe their behavior effectively, (2) the explosives have a memory of the induction process, and (3) the Arrhenius model can accurately predict the critical temperature but not necessarily the time to ignition.

37135 (MHSMP—80-50) Effects of diameter and temperature on XTX-8004 detonation velocity. Campos, C.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1980. Contract AC04-76DP00487. 10p. NTIS, PC A02/MF A01.

This study was performed to determine the dependence of XTX-8004 steady detonation velocity on charge diameter and temperature. The tests were performed for four different diameters at three temperatures using a standard 4-track detonation velocity block and corresponding printed circuit ionization switch plate. The explosive was loaded in the detonation velocity block to a nominal density of 1.553 g/cc. Measurements obtained from two samples per temperature indicate the critical diameter is less than 0.178 cm. A relationship between detonation velocity and density due to temperature was established using experimental measurements.

NUCLEAR

REFER ALSO TO CITATION(S) 37166

37136 (AD-A—079598/9) Experimental investigation of electromagnetic pulse (EMP) propagation in a conduction plasma. Final report 1 oct 75-30 sep 79. Carlile, R.N. (Arizona Univ., Tucson (USA). Dept. of Electrical Engineering). 29 Nov 1979. 20p. NTIS, PC A02/MF A01.

The electromagnetic pulse (EMP) generated by a nuclear detonation has been the subject of extensive study. Computer codes have been developed which attempt to model the generation and propagation of the EMP due to both a high altitude and low altitude detonation. In some of these codes, the current density term which appears in Maxwell's equations due to conduction currents of secondary electons is modeled as a function of conductivity which is spatially and time dependent. A more complete description of the conduction currents is given by the familar fluid transport equations for mass, momentum and energy, which are collectively called the swarm equation.

WEAPONRY

37137 (AD-A—080040/9) **Initial nuclear radiation environments due to tactical nuclear weapons detonated in air-over-ground and air-over-sea geometries. Technical report.** Robitaille, H.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jul 1979. 32p. NTIS, PC A03/MF A01.

Calculations of the free-field neutron and secondary gamma-ray environments generated by the detonation of tactical standard-fission-weapons have been made for air-over-ground and air-over-seawater geometries. These data have been combined with previously published calculations of the radiation environments due to the primary prompt gamma-ray component, in order to predict the total radiation intensities induced along the air-ground interface, for various heights of weapon burst.

EXPLOSION DETECTION

37138 (AD-A—079615/1) **Seismic waveform analysis of underground nuclear explosions. Annual technical report.** Butler, R.; Ruff, L.J.; Hart, R.S.; Mellman, G.R. (Sierra Geophysics, Inc., Arcadia, CA (USA)). 15 Nov 1979. Contract F49620-79-C-0012,. 81p. NTIS, PC A05/MF A01.

The present research program represents an application of the methods of time domain seismology to the observed short period P-waves from underground explosions. The goals were to obtain better estimates of the variation of short period seismic attenuation across the continental United States, evaluate the influence of different source regions on teleseismic P-wave amplitudes and waveforms, quantify the concepts of station/receiver transparency, and develop the initial states of a waveform inversion technique for both source discrimination and source description applications. A significant portion of the work performed on the first and second parts of this task was reported in the Sierra Geophysics Quarterly Technical Reports SGI-R-79-001 and SGI-R-79-004. That research is summarized and some additional work and insights into the implications of the results are included. The last section contains discussions of station transparencies and progress report on waveform inversion techniques.

37139 (AD-A—079982/5) **Regional seismic wave propagation. Semiannual technical report no. 3, 1 Jan-30 Jun 79.** Pomeroy, P.W. (Rondout Associates, Inc., Stone Ridge, NY (USA)). 31 Jul 1979. Contract F49620-78-C-0043,. 43p. NTIS, PC A03/MF A01.

The research reported here was carried out to enhance our understanding of seismic wave propagation at regional distances in the central portion of the USSR. Results in this region are contrasted with those from the Western USSR and with data from eastern North America.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 36237, 36238, 36239, 36249, 36250, 36251, 36252, 36253, 36254, 36255, 36256, 36257, 36258, 36259, 36260

37140 (LA-UR—80-1995) **Simple model for wind field computation from sparse data.** Lee, W.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801107—15). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

An initial attempt to carry out a simple numerical model that will interpolate and smooth the complete wind fields for an arbitrary planar region where only sparse wind data are available is summarized. The model contains four features: any arbitrary planar region with curved or straight line boundaries that do not cross themselves can be treated; the measured wind data can be irregularly distributed in the region; part of the code can be applied to any function that has two independent variables; and irrotational flow is assumed in smoothing the stream function. (ACR)

37141 (UCRL—84058) **Increases in CO_2 and chlorofluoromethanes: coupled effects on stratospheric ozone.** Penner, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Aug 1980. Contract W-7405-ENG-48. 9p. (CONF-800869—1). NTIS, PC A02/MF A01.

From Quadrennial international ozone symposium; Boulder, CO, USA (4 Aug 1980).

The magnitude of the chlorofluoromethane (CFM) induced depletion of the ozone layer is considered a key problem in atmospheric research. The historical rise in the atmospheric concentrations of $CFCl_3$, and CF_2Cl_2, the major CFM species, is well documented. Atmospheric CO_2 has also been increasing. Instead of depleting O_3, the expected effect of CO_2 is to increase its concentration. The simultaneous effects of these perturbations were studied. Results indicate that increases in CO_2 can significantly alter the predicted ozone trend. This will complicate efforts to detect the trend in O_3 caused by increases in CFM's. Since the calculated effects of these perturbations are largest at high altitudes, one might expect to detect changes in high altitude O_3 sooner than those in total O_3. Therefore a comparison was made between the calculated change in O_3 at high altitude and statistical detection limits for abnormal change as developed from Umkehr data from Arosa, Switzerland. Its significance for trend detection is discussed. Finally, since CO_2 effects will be important in the next 50 to 100 years, the effects of temperature changes from CO_2 increase on O_3 loss rates from different families were examined. Significant changes in the NO/sub x/-catalyzed ozone loss rates that have not previously been discussed were found. It is concluded that the O_3 decrease at steady state from the coupled CFM and CO_2 perturbation is larger than the decrease calculated by summing the separate effects of these perturbations. The expected increase in CO_2 can significantly affect predicted O_3 trends in the next 50 to 100 years. O_3 changes in Umkehr level 7 are more detectible, in a statistical sense, than those at higher levels. The temperature effect of CO_2 on the NO/sub x-catalyzed O_3 destruction rate was found to be as large or larger than the effect of temperature on the pure oxygen loss rate.

37142 (UCRL—84547) **Meteorological measurement system for support of atmospheric propagation studies.** Hines, J.; Bingham, G. (Army Atmospheric Sciences Lab., White Sands Missile Range, NM (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 9p. (CONF-8003101—1). NTIS, PC A02/MF A01.

From Workshop on millimeter and submillimeter atmospheric propagation application to radar and missile systems; Redstone Arsenal, AL, USA (22 Mar 1980).

In support of laser system design and testing, a system for meteorological data acquisition, transmission, and processing was designed, developed, and implemented. The system covers optical turbulence, wind, gases, and particulates. The system has been in operation for 2 years and is currently being used to characterize the atmosphere at a high energy laser facility. Optical turbulence instrumentation includes point measurements with a spatial temperature probe, integrated measurements over a 180-m horizontal path with an optical scintillometer, and vertical profiles up to 600 m with an acoustic sounder. Wind speed and direction are monitored with an anemometer system. Gases currently being monitored for concentration include water vapor, ozone, total hydrocarbons, methane, nitrous oxide, and carbon dioxide. Particulate measurements include those of size distribution, mass concentration, and scattering coefficient. Stations at each data acquisition site acquire, preprocess, convert, transmit, and/or store data. The stations are linked to a central computer through bidirectional computer-controlled data links. The central computer handles the data collection, archiving, and formatting.

37143 **Atmospheric turbulence and storm surge due to Hurricane Belle (1976).** SethuRaman, S. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Mon. Weather Rev.;* **107**: No. 3, 314-321(Mar 1979).

Mean and fluctuating winds were measured within the atmospheric surface layer at three locations across Long Island during the landfall of Hurricane Belle on 9 Aug 1976. An order of magnitude increase in wind shear was observed. A maximum friction velocity of $\sim$ 133 cm s^{-1} and a maximum energy dissipation rate of $\sim$ 130 $cm^2\ s^{-3}$ were estimated. Mean wind speeds at the beach were found to be 3 to 5 times the corresponding wind speeds inland. A periodicity in rainfall associated with bands of thundershowers was observed. A storm surge of $\sim$ 125 cm was estimated from water level records near Shinnecock Inlet. The records indicated the three successive stages, forerunner, hurricane surge and resurgence, associated with the hurricane.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 36237, 36784, 37142, 37238

37144 (AD-A—079792/8) **Short-time mass variation in natural atmospheric dust. Technical report.** Barber, T.L. (Army Electronics Research and Development Command, White Sands Missile Range, NM (USA). Atmospheric Sciences Lab.). Nov 1979. 51p. NTIS, PC A04/MF A01.

Aerosols are not perfectly mixed in the atmosphere, but reside in miniclouds, even in a relatively clear atmosphere. This report presents a mathematical treatment relating mass loading to optical backscatter, and some of the inherent problems in examining light scattering from natural dust in a theoretical manner are discussed. Lidar backscatter data were taken in a desert environment and related to mass loading variations over 30-second periods. Four of the 30-second segments of the data are presented. In these four segments, the estimated relative mass loading was observed to fluctuate up and down with the highest mass loading about eight times that of the lowest mass loading. These mass loading fluctuations were observed at one position 15 meters above the ground.

37145 (BNL—51238) **Emissions of CO_2 to the atmosphere due to U.S.A. fossil fuel consumption.** Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1980. Contract AC02-76CH00016. 18p. NTIS, PC A02/MF A01.

Analysis and projection of carbon dioxide emitted to the atmosphere are estimated based on the Brookhaven reference energy system. Some new results are given on carbon dioxide contribution to the atmosphere from US fossil fuel consumption by different sectors including residential, commercial, industrial and transportation. The total weight of carbon as carbon dioxide emitted to the atmosphere and the additional CO_2 concentration over background by different subsectors in the years 1977, 1980, 1985, 1990, 2000 and 2020 are presented.

37146 (DOE/EV—T0002/1) **Summary of the carbon dioxide effects research and assessment program.** (Department of Energy, Washington, DC (USA). Office of Health and Environmental Research). Jul 1980. 34p. NTIS, PC A03/MF A01.

A brief management-oriented summary is presented of the research program. Goals, strategies, selected facts and predictions are presented. (ACR)

37147 (EPRI-EA—1498(Vol.2)) **Plume conversion rates in the SURE region. Final report.** Easter, R.C.; Busness, K.M.; Hales, J.M.; Lee, R.N.; Arbuthnot, D.A.; Miller, D.F.; Sverdrup, G.M.; Spicer, C.W.; Howes, J.E. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 246p. NTIS, PC A11/MF A01.

Results of a study of transformation and transport processes in plumes emitted from fossil-fueled power plants are described. Primary research emphasis was placed upon transformations of sulfur and nitrogen oxides, with the principal objective of generating parameterized transformation relationships suitable for input to models currently being developed for the EPRI Sulfate Regional Experiment Program. Extensive field measurements were performed in late spring and late fall of 1977 at two coal-fired and one oil-fired power plants; the Breed plant in Indiana, the Cobb plant in Michigan, and the Andrus plant in Mississippi. Plume measurements were obtained using an instrumented DC-3 aircraft and included gas concentrations (SO_2, NO/sub x/, O_3, NH_3, HNO_3, hydrocarbons), aerosol composition (SO_4/sup =/, NO_3^-, NH_4^+), and physical aerosol parameters. Source emission measurements were also performed and SF_6 tracer released into the plumes. The resulting data, which include 140 hours of aircraft measurements, have been organized into a data base. Conversion and loss rates of SO_2 and NO/sub x/ were estimated using a varity of ratio techniques, and the results were analyzed using reactive plume models of varying complexity. A parameter-search technique was developed to utilize a reactive plume model to establish candidate conversion expressions for SO_2 transformations. SO_2 was generally found to oxidize in power plant plumes at rates ranging from 0 to 3% hr, depending upon insolation, plume dispersion, and ambient hydrocarbon concentration, as well as possible additional factors. Homogeneous oxidation paths appeared more significant than heterogeneous paths under the conditions observed. Nitrogen oxides data suffer from lower measurement sensitivity, but preliminary indications are that nitrate and nitric acid production proceeds quite slowly in plumes, although substantial total NO/sub x/ losses were sometimes observed.

37148 (LA-UR—80-2604) **Validation and sensitivity of a simulated photograph technique for visibility modeling.** Williams, M.; Chan, L.Y.; Lewis, R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-801114—3). NTIS, PC A02/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

The Los Alamos Scientific Laboratory (LASL) visibility model is capable of producing simulated before and after pictures that illustrate visual effects of smoke plumes. Although the model has been under development for a few years, until recently there had been very little testing of the model against field experience or testing of sensitivity of the model results to numerical approximations used in the model. Further validation and sensitivity testing of the LASL model began in late 1979. The work focused on three areas: comparison of the LASL model results with plumes encountered in the field, comparison of LASL background-atmosphere model results with measured sky intensities, and examination of the variation of model results with changes in the numerical approximations. The field study took place during August of 1979 in the vicinity of coal-fired power plants in northwestern New Mexico and northern Arizona. Telephotometer, NO/sub X/ plume measurements, and aerosol size distribution measurements were made in the plumes of three different coal-fired power plants. Photographs were taken of the plumes, and simulated photographs were prepared by the model. Light intensities calculated by the background radiative transfer model were compared to measured light intensities in a very clean atmosphere and in a moderately hazy atmosphere. The measured intensities were derived from photographic densities. In addition to the field measurements, differences resulting from increased numbers of wavelengths in the color representation were examined. Other changes were also examined in the numerical approximations. The results of these studies are described.

37149 (PNL—3400) **MAP3S precipitation chemistry network. Third periodic summary report, July 1978-December 1979.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 306p. NTIS, PC A14/MF A01.

The MAP3S Precipitation Chemistry Network consists of eight collection sites in the northeastern United States. Precipitation event samples are collected by cooperating site operators, using specially developed sampling equipment. In this, the third periodic summary report, are listed field and concentration data for the period July 1, 1978 to December 31, 1979. Over three years' samples have been collected at most of the sites, which went into operation between September 1976 and October 1978. Samples are chemically analyzed at a central laboratory for 13 pollutant species. Weekly samples in addition to event samples were collected over a 1 1/2 year period at three sites. Analysis of one year's results indicates that there is little difference between the concentrations collected by the two methods in terms of seasonal precipitation-weighted means for all species except dissolved SO_2. Event samples tend to average about 25% higher in SO_2 than weekly samples.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37165

37150 (AD-A—079560/9) **The history of fallout prediction. Report for 1950-1979.** Willis, J.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). 1 Jun 1979. 37p. NTIS, PC A03/MF A01.

The development of the science of fallout prediction in this country from 1950 to 1979 is described. The chronological description emphasizes early developments and the relationships between some of the significant calculational models. The earliest work on fallout prediction discussed in that performed by RAND on Project Aureole in 1954, and the evolution is carried through to the derivatives of the DELFIC computer code. A section is devoted to the histories of four commonly used handbook prediction systems.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 36290

REGULATIONS

37151 (AD-A—079740/7) **The economic effects of environmental expenditures on the construction industry. Research contribution.** Jondrow, J.; Chase, D.; Gamble, C.; Jacobson, L.; Levy, R. (Public Research Inst., Alexandria, VA (USA)). Sep 1979. Contract EPA-68-01-4353. 142p. NTIS, PC A07/MF A01.

Between 1978 and 1985, municipal governments and private industry will spend about $111 billion dollars on construction of new facilities to reduce air and water pollution as mandated by the EPA. This report presents estimates of how these projected expenditures will affect the total level of construction and how employment, wages, interest rates, and other variables will respond to the change in construction output. Effects on employment in selected subclasses of the construction industry were also estimated. The response of the construction industry to increased spending for pollution control was estimated by use of an econometric model of the industry. The model, developed for this study, was simulated to predict the effects of projected spending through 1985. The results suggest that construction output will rise by less than the EPA mandated expenditure. The difference is due, in part, to displacement of spending that local governments would otherwise have done and, in part, to absorption of the increase by rising wages and prices in construction. There is also some displacement of industrial expenditures for pollution abatement because of the increased cost of build-

ing a new plant. The results also suggest that employment in the construction industry is increased. Employment of young, black, inexperienced workers increases more than would be expected based on their representation in the construction labor force.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 37184

37152 Patterns of morphology and ecology in grassland and shrubsteppe bird populations. Wiens, J.A.; Rotenberry, J.T. (Univ. of New Mexico, Albuquerque). Contract AT(45-1)-1830;AT(45-1)-2042. *Ecol. Monogr.;* **50**: No. 3, 287-308(Sep 1980).

We analyze patterns of morphological variation in a guild of 12 species of grassland/shrubsteppe birds in relation to various theories expressing ecomorphological correlations. Variability in morphology over the six geographic locations sampled was moderate for most species, but several morphological traits exhibited significant variation between years at given locations. Sexual variation (dimorphism) was significant for most traits in most species; it was most apparent in polygynously mating forms, but occurred as well in several monogamous species. Dimorphism was generally greater for traits related in a general way to body size than for bill size traits, suggesting a stronger role for sexual selection than for intersexual trophic niche differentiation in driving dimorphism in these species. In nonsexual dimensions of variation, variability in bill features and body measurements tended to be similar. Migratory species did not differ from resident species in the degree of morphological variability. There was heterogeneity as well in the patterns of covariation among morphological traits. Principal component analysis indicated different clusterings or suites of morphological traits in component space for the different species, although in several the first principal component appeared to represent a general body size set. Overall, our analysis casts doubt on the applicability of muchcurrent ecomorphological theory to the bird guilds we studied. We believe that close associations between morphology and ecology are obscured by the substantial variability in both. This variability may reflect the fluctuating selection pressures characteristic of arid and semiarid environments, where environmental stresses (and the attendant tight restriction of population variation in morphology and ecology) are sporadic in their occurrence.

37153 Adult body mass and annual production/biomass relationships of field populations. Banse, K.; Mosher, S. (Univ. of Washington, Seattle). Contract E-76-S-06-2225. *Ecol. Monogr.;* **50**: No. 3, 355-379(Sep 1980).

We investigate specific production rates (per unit biomass) of populations using published data on the relation of annual production/mean biomass (P/B). Aquatic and terrestrial invertebrates between the sizes of copepods and clams are emphasized, ranging about 10^8-fold in body mass upon reaching maturity, and about 10^2-fold in P/B. Fishes and mammals are briefly treated; phytoplankton is mentioned. For 33 invertebrates living at annual mean temperatures between about 5° and 20°C, M/sub s/ is shown to be an efficient and precise estimator, or scaling factor, of the annual P/B. The rate declines markedly with M/sub s/ according to $P/B = 0.65M/sub\ s/^{-0.37}$. The exponent differs significantly from the -0.25 power of comparative physiology. Most of the measured values of P/B fall within 50 to 200% of predicted values. Much of this variability is associated with the ratio of annual production/annual respiration (P/R): for a given M/sub s/, species achieving about half the predicted P/B have P/R ratios of about 0.1; those achieving twice the predicted P/B have P/R ratios of about 1.0. Age upon reaching maturity contributes some variability, with late-maturing (> 1 yr) species tending towards a higher P/B. The variability is not significantly correlated with phylogenetic relationships (excepting insects for which P/B might not be mass-dependent), trophic type, major habitat, production rate, or biomass of the populations.

37154 Response to fertilization by various plant growth forms in an Alaskan tundra: nutrient accumulation and growth. Shaver, G.R. (San Diego State Univ., CA); Chapin, F.S. III. Contract EE-77-03-1525. *Ecology;* **61**: No. 3, 662-675(Jun 1980).

The fertilization responses of six tundra species belonging to three plant growth forms were compared to test the hypothesis that species of the same plant growth form are more similar to one another than to other growth forms in their response to a controlled perturbation. The controlled perturbation was a complete factorial NPK fertilization experiment in tussock tundra at Eagle Creek, Alaska, USA. We compared deciduous shrubs, evergreen shrubs, and functionally deciduous graminoids in terms of mineral and total nonstructural carbohydrate (TNC) concentrations, and annual production per stem or tiller.

37155 Properties of food webs. Pimm, S.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Ecology;* **61**: No. 2, 219-225(Apr 1980).

On the assumption that systems of interacting species, when perturbed from equilibrium, should return to equilibrium quickly, one can predict four properties of food webs: (1) food chains should be short, (2) species feeding on more than one trophic level (omnivores) should be rare, (3) those species that do feed on more than one trophic level should do so by feeding on species in adjacent trophic levels, and (4) host-parasitoid systems are likely to be exceptions to (1)-(3) when interaction coefficients permit greater trophic complexity. By generating random, model food webs (with many features identical to webs described from a variety of marine, freshwater, and terrestrial systems), it is possible to generate expected values for the number of trophic levels and the degree of omnivory within webs. When compared with these random webs, real world webs are shown to have fewer trophic levels, less omnivory, and very few omnivores feeding on nonadjacent trophic levels. Insect webs are shown to have a greater degree of omnivory than other webs. The confirmation of all these predictions from stability analyses suggests that system stability places necessary, though not sufficient, limitations on the possible shapes of food webs.

37156 Aerial production, mortality, and mineral accumulation-export dynamics in Spartina alterniflora and Juncus roemerianus plant stands in a Georgia salt marsh. Gallagher, J.L.; Reimold, R.J.; Linthurst, R.A.; Pfeiffer, W.J. (Univ. of Georgia Marine Inst., Sapelo Island). Contract ORO-3238. *Ecology;* **61**: No. 2, 303-312(Apr 1980).

Biomass and disappearance of dead material were measured in stands of tall creek bank Spartina alterniflora, short high marsh S. alterniflora, and Juncus roemerianus in Georgia, USA at 4-wk intervals for 1 yr and at 8-wk intervals for a second yr. Growth and mortality were calculated from these data. Net primary production estimates, using changes in biomass only, ranged from 10 to 75% lower than estimates which included the disappearance of dead material. Agreement between the methods was closest when the interval between harvests was shortest and the rate of dead material disappearance the slowest. Estimates of mean annual net primary production, computed from changes in biomass and disappearance of dead plant material, were: creekbank S. alterniflora 3700 g/m^2, high marsh S. alterniflora 1300 g/m^2, and J. roemerianus 2200 g/m^2. The seasonal amplitude in the amount of N, P, K, Ca, and Mg in the living tissue was greatest in the creekbank S. alterniflora. The maximum accumulation of most elements was in late summer. In the tissue of S. alterniflora, N and P were highest in concentration in late winter and early spring. In summer, growth occurred faster than nutrient accumulation; therefore, tissue concentrations decreased. Seasonal patterns of element disappearance from the dead plant community showed that maximum export depended on community type and the element under consideration.

37157 Sceloporus undulatus: comparative life history and regulation of a Kansas population. Ferguson, G.W. (Texas Christian Univ., Forth Worth); Bohlen, C.H.; Woolley, H.P. Contract EY-76-C-09-0819. *Ecology;* **61**: No. 2, 313-322(Apr 1980).

The demography of a small, isolated population of the lizard Sceloporus undulatus garmani from eastern Kansas, USA was studied for 5 yr. Growth rates were relatively rapid; age of maturity, relatively low; clutch size was small and decreases in successive clutches of the same females; juvenile survival, while low, was high for the species; adult survival was relatively low. The population size was the most variable yet studied. Winter-spring mortality rates, probably due to predation, were constant regardless of density, but density-dependent mortality operated in at least 1 yr during this period. Summer-fall recruitment was density dependent, probably due to predation on egg-laying females, but flooding and possible temperature-dependent predator susceptibility resulted in instability of the population size. The population is probably below its resource limits most of the time. The comparative demography of this and eight other populations of S. undulatus reported in the literature was summarized. There are three ecological regions to which this species has adapted: eastern woodland, grass lands, and canyonlands. There are both regional and latitudinal differences in suites of correlated traits, but comparative data on ecological pressures are not sufficient to support any single current theory of how these different populations are adapted.

37158 Comparative error analysis of six predator-prey models. Gardner, R.H.; O'Neill, R.V.; Mankin, J.B.; Kumar, D. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Ecology;* **61**: No. 2, 323-332(Apr 1980).

Six models were devised for a hypothetical predator-prey system. The models differed in functional forms, but were calibrated to display similar output for a standard annual cycle. Parameters were assumed to be measured with error, and this uncertainty was

propagated through the models by Monte Carlo simulation. Total uncertainty on model output was partitioned, for each model, into six component sums of squares, and components were examined as they changed over the simulated annual cycle. The results indicate that the models differ in their error propagation properties with more complex functions often generating greater uncertainty on output. The contribution of a specific model term to overall error is dependent on its mathematical form (especially, the partial derivative of the term with respect to the parameter) and also its position within the total model. No single model showed the smallest output uncertainty for all possible modeling objectives. The results indicate that the most useful data for testing a model should be gathered during periods of the year when the state variables are changing most rapidly.

37159 Morphology, surface temperatures, and northern limits of columnar cacti in the Sonoran Desert. Nobel, P.S. (Univ. of California, Los Angeles). *Ecology;* **61**: No. 1, 1-7(Feb 1980).

Interspecific morphological differences and intraspecific morphological changes with latitude were evaluated to help examine the distributional ranges of Carnegiea gigantea, Lemaireocereus thurberi, Lophocereus schottii, Pachycereus pecten-aboriginum, and P. pringlei in the Sonoran Desert (US and Mexico). A computer model, which predicted the average surface temperature of the stem within 1°C of that measured hourly throughout a 24-h period, was particularly useful in studying the thermal relations of the stem apex, where the lowest surface temperature occurred. Simulated increases in stem diameter raised the minimum apical temperature for C. gigantea and may help account for the extension of its range to higher latitudes than the other species studied. However, diameter increases led to a slight decrease in minimum apical temperatures for Lophocereus schottii. The immature stems of L. schottii are morphologically distinct from the mature stems, which caused minimum apical temperatures to be 1.6°C lower for the immature stems under given environmental conditions; thus, freezing damage to the immature stems could limit the northward extension of the range of this species. As the apical pubescence in the simulations was increased up to the normal amount (10 mm), the minimum apical temperature for the stem of C. gigantea increased 2.4°C. Simulated increases in spine shading of the apexalso raised the minimum apical temperatures, again indicating the influence of morphological features on the temperature of the meristematic region.

37160 Thermal and hydric aspects of environmental heterogeneity in the pitcher plant mosquito. Kingsolver, J.G. (Univ. of Wisconsin, Madison). Contract EY-76-S-02-2270. *Ecol. Monogr.;* **49**: No. 4, 357-376(Dec 1979).

In an attempt to define environmental heteogeneity and uncertainty in a meaningful manner, thermal and hydric aspects of the microenvironment of the pitcher plant mosquito (Wyeomyia smithii) were studied. Mechanistic mass and energy balance models were developed to predict surface temperatures in a Sphagnum bog and temperatures and water losses in Sarracenia purpurea pitchers. Field tests indicate that the models predicted surface and pitcher temperatures within 2 to 3°C, and hourly and daily water losses from pitchers to within 30%, using only basic meteorological data as inputs. Experiments and observations in a natural population of W. smithii in northern Michigan, USA revealed significant differences in larval developmental rate, voltinism, and larval mortality due to microclimatic effects. The model predicts larval developmental rates and voltinism for each micmicroclimate within 10%. Water loss smulations predict, and field observations confirm, that pitcher desiccation is a function of microclimate and pitcher size, and that rainfall patterns on the order of 5 to 30 d determine desiccation patterns. Identification of the spatial and temporal scale of both the environment and the organismic (population) phenomena in question is crucial to constructing a meaningful definition of environmental heterogeneity. Thermal and hydric components of environmental variation may plan an important role in the maintenance of fitness variation in W. smithii. These results support the hypothesis of Istock (1978) that environmental uncertainty favors mixed life history strategies in Wyeomyia.

37161 Late quaternary vegetation history of the eastern Highland Rim and adjacent Cumberland Plateau of Tennessee. Delcourt, H.R. (Univ. of Minnesota, Minneapolis). Contract W-7405-ENG-26. *Ecol. Monogr.;* **49**: No. 3, 255-280(Sep 1979).

Vegetation change during the past 25,000 years in and near the present Mixed Mesophytic Forest Region is inferred from pollen and plant macrofossil analyses of sediment cores from two sites on the eastern Highland Rim of Middle Tennessee, USA. Anderson Pond, in White County, dates from 25,000 radiocarbon years BP to present. Mingo Pond, Franklin County, Tennessee, contains a pollen record estimated to extend back to 14,000 y BP. Stratigraphic sites from the Missouri Ozarks to the Atlantic Coastal Plain date the full glacial in the southeastern United States between 23,000 and 16,500 y BP. During the glacial maximum, boreallike coniferous forests of spruce, jack pine, and fir extended southward to 34°N latitude. Mesic deciduous forest persisted through the full glacial at 35°N at Nonconnah Creek near Memphis. Fullglacial refuges for deciduous forest species may have also existed in south-facing gorges of the Cumberland Plateau and southern Appalachian Mountains in addition to bluffs along major streams in the southeastern United States. During the late glacial, beginning about 16,500 y BP, boreal-like coniferous forest was replaced in midlatitudes (34°N) by cool-temperate coniferous-deciduous forest. In the early Holocene, between 12,500 and 8000 y BP, cool-temperate mixed mesophytic forest prevailed between 34°N. The Mixed Mesophytic Forest Region assumed its present distribution in the mid-Holocene.

37162 Distribution and abundance of soil arthropods in the Northern Mojave desert. Franco, P.J. (Univ. of California, Los Angeles); Edney, E.B.; McBrayer, J.F. *J. Arid Environ.;* **2**: No. 2, 137-149(Jun 1979).

Arthropods were extracted from soil samples taken from around four perennial plant species in Rock Valley, Nevada, from January to December 1974. The pattern of distribution of the arthropods about the shrubs is described and a model has been constructed to estimate population densities and biomasses. Total arthropod densities ranged from 1600 per m^2 in July to 12,400 per m^2 in December. Total biomass was also lowest in July, 8.7 mg/m^2, and reached 37.2 mg/m^2 in May. The majority of animals collected belonged to the Acari, and of these the Cryptostigmata and the prostigmatid families, Nanorchestidae and Tydeidae, were most abundant. Seasonal variations in the distribution patterns are discussed.

37163 Effects of watershed perturbation on stream potassium and calcium dynamics. Webster, J.R.; Patten, B.C. (Univ. of Georgia, Athens). *Ecol. Monogr.;* **49**: No. 1, 51-72(Mar 1979).

Three small streams located at Coweeta Hydrologic Laboratory, North Carolina, USA, on an old field watershed, a pine plantation watershed, and a hardwood forest watershed were investigated to determine effects of watershed perturbation on K and Ca dynamics in the stream ecosystems. Data collected included measurements of litterfall inputs, large particulate organic matter and benthic organism standing crops, large particulate organic matter and organism drift, and insect emergence. We used ^{85}Sr and ^{134}Cs to estimate detritivore ingestion and elimination rates of Ca and K, respectively. We found that watershed perturbations had altered stream inputs and caused accompanying changes in the stream fauna. Our results indicated that the perturbed streams had less efficient physical processing of allochthonous inputs, but greater biological utilization of inputs. The streams exhibited high resilience to perturbation with complete recovery limited by the recovery rate of allochthonous inputs.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37170, 37238

37164 Measurement of adsorption on solids by the axial filter; linear vs nonlinear isotherms. Egozy, Y. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Soil Sci. Soc. Am. J.;* **44**: No. 3, 483-489(May 1980).

Use of the axial filter for adsorption measurements and evaluation of distribution coefficient is described. Adsorption of Sr(II), Co(II), and Cd(II) on Na montmorillonite from solutions of a wide range of NaCl concentration was measured by the axial filter and compared with results obtained by other experimental methods. Agreement was found for Sr(II) and Cd(II) systems. Disagreements between batch and axial filters results for Co(II) adsorption appear to rise mainly from the slow kinetics of the Co(II) adsorption. Adsorption of Sr(II) on alumina was used to demonstrate the application of the axial filter method for a nonlinear isotherm case. The nonlinear isotherm, obtained by a batch method, was used to explain the behavior of the system in an axial filter experiment. Good agreement was obtained between the predicted and the experimental axial filter results.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

37165 (RFP—2866) Environmental studies group. Annual report for 1978. Hunt, D.C.; Hurley, J.D. (eds.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 21 Aug 1980. Contract AC04-76DP03533. 105p. NTIS, PC A06/MF A01.

Group projects included radioecological studies of aquatic and terrestrial systems, land management activities, foodstuff monitoring, dust transport studies including fugitive dust measurements and modeling, and several support programs involving evaluation of the plant's ambient air samplers and airborne tritium monitoring techniques. Some salient results from the several project reports include determination of an appropriate model for mechanically

generated fugitive dust dispersion, a radionuclide inventory of Smart Ditch Pond (Pond D-1), a coefficient of community determination for two terrestrial sample plots on the plant site buffer zone, a natality and mortality rate determination for fawns in the plant deer herd (including one positive coyote-kill determination), inlet loss and filter paper collection efficiencies for the plant ambient air samplers, and differential tritium sampling measurements of the vapor in Building 771 stack effluent.

SOIL

REFER ALSO TO CITATION(S) 36114, 36138, 36154, 36155, 36156, 36157, 36158, 36159, 36160, 36161, 36162, 37181

37166 (NVO—225) **Tatum Dome Project, Lamar County, Mississippi.** Fenske, P.R.; Humphrey, T.M. Jr. (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Aug 1980. 413p. NTIS, PC A18/MF A01.

The Tatum Dome site, near Hattiesburg, Mississippi, has been host to two nuclear detonations and two nonnuclear gas detonations. The top of the cavity formed by the detonations was 2660 feet below land surface and 1160 feet below the top of the salt dome. All detonations were totally contained within the salt dome in which they were fired. Activities at the site occurred between 1964 ad 1970. In 1978, NV was asked to provide proof that radiological contamination was not adversely affecting water quality in the aquifers over Tatum Dome. All except the Surficial Aquifer, which was known to be contaminated by tritium, were extensively tested to obtain hydrological data. Sufficient samples were taken to determine if contamination existed in the aquifer around the emplacement casing at surface ground zero (SGZ). Low tritium concentrations were found in the Local Aquifer, approximately 150 to 200 feet below land surface, during this project, but no radioactivity was found in any of the other aquifers above Tatum Dome. The Local Aquifer is the next aquifer below the Surficial Aquifer.

37167 (PNL—3497) **Environmental radiation safety: source term modification by soil aerosols. Interim report.** Moss, O.R.; Allen, M.D.; Rossignol, E.J.; Cannon, W.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 48p. NTIS, PC A03/MF A01.

The goal of this project is to provide information useful in estimating hazards related to the use of a pure refractory oxide of ^{238}Pu as a power source in some of the space vehicles to be launched during the next few years. Although the sources are designed and built to withstand re-entry into the earth's atmosphere, and to impact with the earth's surface without releasing any plutonium, the possibility that such an event might produce aerosols composed of soil and $^{238}PuO_2$ cannot be absolutely excluded. This report presents the results of our most recent efforts to measure the degree to which the plutonium aerosol source term might be modified in a terrestrial environment. The five experiments described represent our best effort to use the original experimental design to study the change in the size distribution and concentration of a $^{238}PuO_2$ aerosol due to coagulation with an aerosol of clay or sandy loam soil.

37168 (PNL—3545) **Environmental radiation safety source term evaluation program.** Moss, O.R.; Filipy, R.E.; Cannon, W.C.; Craig, D.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1977. Contract AC06-76RL01830. 89p. NTIS, PC A05/MF A01.

Plutonium-238 is currently used in the form of a pure refractory oxide as a power source on a number of space vehicles that have already been or will be launched during the next few years. Although the sources are designed and built to withstand re-entry into the earth's atmosphere and impact with the earth's surface without releasing any plutonium, the possibility of such an event can never be absolutely excluded. Three separate tasks were undertaken in this study. The interactions between soils and $^{238}PuO_2$ aerosols which might be created in a space launch about environment were examined. Aging of the plutonium-soil mixture under a humid atmosphere showed a trend toward the slow coagulation of two dilute aerosols. Studies on marine animals were conducted to assess the response of $^{238}PuO_2$ pellets to conditions found 60 feet below the ocean surface. Ultrafilterability studies measured the solubility of $^{238}PuO_2$ as a function of time, temperature, suspension concentration and molality of solvent. (ACR)

37169 **Solubility of plutonium compounds and their behavior in soils.** Dhanpat Rai; Serne, R.J.; Moore, D.A. (Battelle, Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Soil Sci. Soc. Am. J.;* **44**: No. 3, 490-495(May 1980).

The solubilities of $^{239}PuO_2$ (c) (crystalline) and $^{239}Pu(OH)_4$ (am) (amorphous) under natural environmental conditions were determined. These data were then used to predict the (i) nature of the solid phases present in contaminated soils, and (ii) total concentration of Pu that can be expected in soil solutions when these Pu solids are present. Based upon solubility measurements, an estimated value of the log K/sup c/ (equilibrium constant at room temperature and an approximate ionic strength of 0.0045) for the dissolution of $^{239}PuO_2$(c) [PuO_2(c) reversible $PuO_2^+ + e^-$] was found to be -14.8. The estimated value of the log K/sup c/ for the dissolution of $^{239}Pu(OH)_4$(am) [$Pu(OH)_4$(am) reversible $PuO_2^+ + 2\ H_2O + e^-$] was found to be -12.8. Comparison of Pu concentration in equilibrium solutions of contaminated Hanford soils with the PuO_2(c) and $Pu(OH)_4$ (am) solubility lines suggested that $Pu(OH)_4$(am) was absent from all the samples and that two of the samples contained PuO_2(c). The presence of PuO_2(c) was also confirmed by x-ray diffraction of Pu particles isolated from one of the samples.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 36111, 36140

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 35981, 36107, 36327, 37253, 37256, 37259

37170 (PNL—3391) **Assessment of environmental health and safety issues associated with the commercialization of unconventional gas recovery: Tight Western Sands.** Riedel, E.F.; Cowan, C.E.; McLaughlin, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1980. Contract AC06-76RL01830. 60p. NTIS, PC A04/MF A01.

Results of a study to identify and evaluate potential public health and safety problems and the potential environmental impacts from recovery of natural gas from Tight Western Sands are reported. A brief discussion of economic and technical constraints to development of this resource is also presented to place the environmental and safety issues in perspective. A description of the resource base, recovery techniques, and possible environmental effects associated with tight gas sands is presented.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

37171 (DOE/EV/04706—7) **Distribution of marine birds on the mid- and North-Atlantic US outer continental shelf. Technical progress report, January 1978-July 1980.** Powers, K.D.; Pittman, G.L.; Fitch, S.J. (Manomet Bird Observatory, MA (USA)). Sep 1980. Contract AS02-78EV04706. 174p. NTIS, PC A08/MF A01.

The species composition, distribution, and abundance of marine birds on continental shelf waters from Cape Hatteras to the Bay of Fundy were examined using ships-of-opportunity. Northern Fulmar, Cory's Shearwater, Greater Shearwater, Sooty Shearwater, Wilson's Storm-Petrel, Gannet, Red Phalarope, Great Black-backed Gull, Herring Gull, and Black-legged Kittiwake were the most abundant and common species. These species were ecologically dominant within the bird community in numbers and biomass. Georges Bank and Gulf of Marine regions generally had greatest estimates of standing stock and biomass; whereas, in the Middle Atlantic region these estimates were consistently lowest. Species diversity throughout the study area was greatest in spring and least in fall. Oceanic fronts at the continental shelf break and at Nantucket Shoals influenced the distribution of Wilson's Storm-Petrels and Red Phalaropes. Fishing activities were particularly important to Larus gull distribution. Fishes, squids, and crustaceans were the most important groups of prey items in diets of nine bird species. An oiled bird or pollution index was developed. According to the index, frequency of oiled birds was greatest in winter and spring, and gulls made up the majority of species with oiled plumages.

37172 (LA—8504-PR) **Water supply at Los Alamos during 1979. Progress report.** Purtymun, W.D. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 46p. NTIS, PC A03/MF A01.

The municipal and industrial water supply for Los Alamos for 1979 consisted of 1407 x 10^6 gal from wells in three fields and 44 x 10^6 gal from the gallery in Water Canyon. Another 0.2 x 10^6 gal of water were pumped to waste during the testing of Well LA-6. About 3.7 x 10^6 gal of water from Guaje Reservoir and 1.3 x 10^6 gal of water from Los Alamos Reservoir were used for irrigation; thus, the total use was about 1456 x 10^6 gal. Water level trends in the wells were as anticipated under current production practices. Well and distribution system rehabilitation should be continued. The rehabilitation of older wells and drilling and development of new wells are

necessary to ensure an adequate and reliable water supply for municipal and industrial use at Los Alamos.

37173 Abundance of estuarine larval and juvenile fish in a South Carolina intertidal creek. Bozeman, E.L. Jr.; Dean, J.M. (Univ. of South Carolina, Columbia). Contract E(38-1)869. *Estuaries;* **3**: No. 2, 89-97(Jun 1980).

The fall and winter population of larval fish in a small intertidal creek was measured. The creek was blocked at high tide, and the immature fish were captured in a channel net designed for consistent quantitative sampling as they left with the ebbing tide. A total of 573,739 individuals with a biomass (preserved wet weight) of 66.1 kg were captured during the eight month sampling period (October 1974 to May 1975). Twelve families, 13 genera, and 16 species were represented, with five species comprising 99.3% of the fish captured. The five species were: Leiostomus xanthurus (53.5%), Lagodon rhomboides (31.7%), Brevoortia tyrannus (11.9%), Micropogon undulatus (1.7%), and Myrophis punctatus (0.5%). The net was efficient, the catch was seasonal, and the greatest larval abundance occurred in February and March.

37174 Formulation and validation of a mathematical model of phytoplankton growth. Collins, C.D. (Rensselaer Polytechnic Inst., Troy, NY). *Ecology;* **61**: No. 3, 639-649(Jun 1980).

A submodel for internal nutrients, critical to prediction of phytoplankton growth dynamics, is described. Process equations were developed to represent storage of nutrients with separate mechanisms for nutrient uptake and assimilation, multiple-nutrient limitation by the threshold hypothesis, and light-dependent photorespiration. These have been incorporated into the ecosystem model MS. CLEANER and calibrated for Ovre Heimdalsvatn, Norway, an ultra-oligotropic, subarctic lake. The model has been validated for Vorderer Finstertaler See, Austria.

37175 Microhabitat resource use, activity patterns, and episodic catastrophe: Conus on tropical intertidal reef rock benches. Leviten, P.J.; Kohn, A.J. (Univ. of Washington, Seattle). Contract AT-(29-2)-266;AT-(26-1)-628. *Ecol. Monogr.;* **50**: No. 1, 55-75(Mar 1980).

Low species richness (five to nine species) and high population density (means of 0.2-8.6 individuals per square metre) characterize Conus assemblages on intertidal benches throughout the tropical Indo-West Pacific region. Data from 16 such habitats in Hawaii, Marshall Islands, Australia, Maldives, and Seychelles indicate that similarity of microhabitats between species is equal to or greater than random expectation. Significant between-species differences in zonation pattern occur across benches at a given time and place. The peak of C. ebraeus abundance typically occurs closest to shore; C. chaldaeus and C. sponsalis are usually most distant from shore. However, we found about as many significant within-species differences between censuses made at different times on the same bench as between-species differences within censuses. Co-occurring species thus tend not to use microhabitat resources differentially. Physical environmental variables including tide level, strength of water flow and time of day determine refuging and foraging activity patterns, and all species apear to respond similarly to these factors. The data thus do not support the hypothesis of temporal resource partitioning. We found evidence neither for homing, as mark-recapture results suggested that individuals occupy any convenient refuge after foraging, nor for interference competition for protected sites among Conus. Conus species diversity is significantly correlated with (1) substrate topographic diversity measured either independently or as the diversity of microhabitats utilized by all species together, and (2) the proportion of individuals occupying protected sites.

RADIOMETRIC TECHNIQUES

37176 (CONF-800862—1) **Role of microbes associated with organic and inorganic substrates in phosphorus spiralling in a woodland stream.** Elwood, J.W.; Newbold, J.D.; O'Neill, R.V.; Stark, R.W.; Singley, P.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From 21. congress of International Association of Theoretical and Applied Limnology; Kyoto, Japan (24 Aug 1980).

Laboratory and field experiments were conducted to determine if nutrient spiralling is primarily a biological process. The experiments were conducted to examine the role of microbial uptake and abiotic sorption onto organic and inorganic substrates in the uptake of PO_4-P in Walker Branch, a small, first-order woodland stream in east Tennessee, to estimate the total, microbial, and adsorptive pool sizes of exchangeable phosphorus associated with five particulate organic matter from this stream, and to measure the turnover rate of PO_4-P by live and sterile inorganic substrates in Walker Branch.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 35975, 37170, 37238, 37250

37177 (BNL—51189) **Geological and hydrochemical sensitivity of the eastern United States to acid precipitation.** Hendrey, G.R.; Galloway, J.N.; Norton, S.A.; Schofield, C.L.; Shaffer, P.W.; Burns, D.A. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 100p. NTIS, PC A05/MF A01.

A new analysis of bedrock geology maps of the eastern US constitutes a simple model for predicting areas which might be impacted by acid precipitation and it allows much greater resolution for detecting sensitivity than has previously been available for the region. Map accuracy has been verified by examining current alkalinities and pH's of waters in several test states, including Maine, New Hampshire, New York, Virginia and North Carolina. In regions predicted to be highly sensitive, alkalinities in upstream sites were generally low. Many areas of the eastern US are pinpointed in which some of the surface waters, especially upstream reaches, may be sensitive to acidification. Pre-1970 data were compared to post-1975 data, revealing marked declines in both alkalinity and pH of sensitive waters of two states tested, North Carolina, where pH and alkalinity have decreased in 80% of 38 streams and New Hampshire, where pH in 90% of 49 streams and lakes has decreased since 1949. These sites are predicted to be sensitive by the geological map on the basis of their earlier alkalinity values. The map is to be improved by the addition of a soils component.

37178 (DOE/EV/04734—T1) **Feasibility of methods and systems for reducng LNG tanker fire hazards.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1980. Contract AC02-78EV04734. 342p. NTIS, PC A15/MF A01.

In this program concepts for reducing fire hazards that may result from LNG tanker collisions are identified and their technical feasibility evaluated. Concepts considered include modifications to the shipborne LNG containers so that in the event of a container rupture less of the contents would spill and/or the contents would spill at a reduced rate. Changes in the cargo itself, including making the LNG into a gel, solidifying it, converting it to methanol, and adding flame suppressants are also evaluated. The relative effectiveness and the costs of implementing these methods in terms of increased cost of gas at the receiving terminal, are explained. The vulnerability of an LNG tanker and its crew to the thermal effects of a large pool fire caused by a collision spill is estimated and methods of protecting the crew are considered. It is shown that the protection of ship and crew so that further deterioration of a damaged ship might be ameliorated, would require the design and installation of extraordinary insulation systems and life support assistance for the crew. Methods of salvaging or disposing of cargo from a damaged and disabled ship are evaluated, and it is concluded that if the cargo cannot be transferred to another (empty) LNG tanker because of lack of availability, then the burning of the cargo at a location somewhat distant from the disabled tanker appears to be a promising approach. Finally, the likelihood of the vapors from a spill being ignited due to the frictional impact of the colliding ships was examined. It is found that the heating of metal sufficient to ignite flammable vapors would occur during a collision, but it is questionable whether flammable vapor and air will, in fact, come in contact with the hot metal surfaces.

37179 (EPRI-CS—1513) **Adsorption/coprecipitation of trace elements from water with iron oxyhydroxide.** Leckie, J.O.; Benjamin, M.M.; Hayes, K.; Kaufman, G.; Altmann, S. (Stanford Univ., CA (USA). Dept. of Civil Engineering). Sep 1980. 262p. NTIS, PC A12/MF A01.

This study has examined the adsorptive/coprecipitation behavior of several inorganic cations and anions in systems containing freshly precipitated x-ray amorphous iron oxyhydroxide. The project examined experimentally several simple, well-characterized model systems to establish type behavior in sufficient detail to allow interpretation of subsequent experimental work on less well-characterized waste materials. A prominent feature of this project was evaluation of the feasibility of utilizing iron-bearing waste liquids as source materials for the precipitation of amorphous iron oxyhydroxide in trace element removal processes. The roles of complexing ligands and competing metals and ligands, and their significance in controlling the distribution of trace elements at the solution/oxide interface have been characterized. From this research a new semi-quantitative model of oxide surfaces has been proposed, as well as a model to describe adsorption of various metal-ligand complexes. Experimental results indicate the adsorption/coprecipitation process with amorphous iron oxyhydroxide is feasible for removing trace elements from a variety of power plant waste streams. In addition, the feasibility of using an acid-metal cleaning waste containing high concentrations of dissolved iron as the iron source for coprecipitation of trace elements has been confirmed. The adsorptive removal of trace elements from real waste streams in complex systems (real wastes) using either reagent iron sources or acid-metal cleaning waste can be interpreted in terms of the generalized behavior of model systems. Trace elements considered included Zn, Cd, and Cu, selenites, chromates, and arsenates.

37180 (Y/DK—255) **Analysis of selected organic priority pollutants in environmental samples.** McElhaney, R.J.; Mann, M.L. (Oak Ridge Y-12 Plant, TN (USA)). 26 Sep 1980. Contract W-7405-ENG-26. 37p. (CONF-801044—1). NTIS, PC A03/MF A01.

From 24. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (7 Oct 1980).

The analysis of drinking water for pesticides, herbicides, and volatile organic compounds will probably be the environmental analytical chemist's introduction to the Environmental Protection Agency (EPA) list of organic priority pollutants. The State of Tennessee requires that drinking water be monitored for lindane, endrin, methoxychlor, toxaphene, 2,4-D, silvex, and the trihalomethanes (THM). In the past two years our attention has been particularly focused on the analysis of polyclorinated biphenyl (PCB) in an increasingly wide variety of sample types. This paper will describe the Oak Ridge Y-12 Plant Laboratory's experience in the analysis of environmental samples for these particular organic priority pollutants by gas chromatography with electron capture detection. Preparation and cleanup procedures for many sample types, chromatographic interpretation, column selection, and confirmatory tests will be discussed and evaluated.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37165

WATER

37181 **Tests of porous permeable medium hypothesis for flow over long distances in fractured deep hard rock.** Bourke, P.J.; Hodgkinson, D.P. (UKAEA Atomic Energy Research Establishment, Harwell); Gale, J.E. (Waterloo Univ., Ontario (Canada)); Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 157-171 of Low flow, low-permeability measurements in largely impermeable rocks. Paris, France; OECD (1979).

From Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks; Paris, France (19 Mar 1979).

Experiments are proposed to test the hypothesis that water movement over long distance through fractures in deep, hard rock can be treated as flow through an effectively porous, permeable medium. Water flow rate into the rock from various lengths of an injection hole and pressure rises at various distances from this hole will be measured to determine the effective permeability and to test if it is constant. The movement of tracers with the water flow will be studied to determine the average and any variation of the porosity and will simulate accelerated leakage over appreciable distances from radioactive waste depositories. An experiment to measure the in-situ compressibility of the rock is also suggested. Existing data are analyzed to quantify the ranges of conditions in which these experiments may be practical.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 37168, 37226

REGULATIONS

REFER ALSO TO CITATION(S) 37151

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 36545, 36772

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 35937, 36724, 36725, 36729, 36750, 36762, 37151

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 36675, 36725, 36731, 36738

37182 (DOE/EDP—0056) **Enviromental Development Plan: special nuclear materials production.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Environment). Jul 1980. 42p. NTIS, PC A03/MF A01.

This Environmental Development Plan includes the process steps and facilities necessary for the production of plutonium and tritium for Government needs and the production of some other radioactive materials that will be used for heat and radiation sources by domestic and international customers. The production reactors and the spent fuel processing plants and their effluents are discussed, but the defense wastes from them are treated in a separate EDP. The scope does not include transportation, decontamination and decommissioning, safeguards and security, or use of the SNM products.

37183 **Impacts of new energy technologies as measured against reference energy systems.** Beller, M.; Doernbert, A.; Hermelee, A.; Hoffman, K. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Energy (Oxford);* **4**: 891-909(1979).

Many technical options and policy options are available to decision-makers in the energy field. Each of these options will have specific and distinct effects on the efficiency, cost, and environmental attributes of the energy system that must be analyzed and understood through policy analyses performed in support of decision-making in industry and government. The comprehensive analyses that must be performed on a technical or policy option include engineering process studies; economic analysis; and the analysis of the transport, conversion, and health impacts of pollutants. Many analytical techniques are employed in this comprehensive analysis. The results, however, must be integrated in a complete but straightforward representation and expressed in the context of the overall system. The Reference Energy System was developed for this purpose. It is a physical description of the energy flows in the system from resources to end use, augmented with compilations of economic and environmental attributes associated with those flows. The Reference Energy System has been applied to energy policy analysis at the national level in industrialized and developing countries and at the regional level. It has been used as an integrating framework in a number of energy-economic analyses. By emphasizing the physical structure of the supply and end-use system, it allows for the insertion of specificoptions that are designed to effect changes in the energy system. The results of the application of this technique to the assessment of alternative energy technologies and energy strategies are described.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 37157, 37158, 37175, 37228

37184 **Dietary relationships among shrumsteppe passerine birds: competition or opportunism in a variable environment.** Rotenberry, J.T. (Oregon State Univ., Corvallis). Contract E(45-1)-2042. *Ecol. Monogr.;* **50**: No. 1, 93-110(Mar 1980).

The suggestion that in less stable environments resource limitation and subsequent interspecific competition may be relatively unimportant in determining bird community structure is explored by examining the dietary relationships within a guild of three ground-foraging passerine birds (Horned Lark, Sage Sparrow, and Western Meadowlark) in the shrubsteppe of southeastern Washington, USA, an area of severe, arid, unstable climate. General dietary analyses indicated a strong temporal component to the organization of bird diets: different species collected at the same time ate much the same things while the same species collected at different times ate different things. This pattern is reinforced by cluster analysis and stepwise discriminant analysis. Similarities in diet extended to other components as well. Dietary diversities tended to be the same for contemporaneous collections of birds, as did averge prey sizes, although the latter evidenced a few statistically significant exceptions. Theoretically predicted relationships between diet and trophic structure morphology emerged only at the most general level, and even then were not always observed. In general, differences in body size or bill length were insufficient to account for variations in prey sizes, although meadowlarks did on occasion take significantly larger items than the other, smaller species. Average prey size was significantly correlated with the proportion of seeds in the diet and varied seasonally as seed consumption varied. Several aspects of this study indicate that shrubsteppe passerines are largely opportunistic in their foraging and diet selection, and that the apparent absence of fine tuning to their competitive milieu is most likely a function of the variable environment in which they coexist.

37185 Self-protecting transistor oscillator for treating animal tissues. Doss, J.D. (to Dept. of Energy). US Patent 4,189,685. 19 Feb 1980. Filed date 14 Mar 1978. 4p.
PAT-APPL-886,378.

This patent describes a transistor oscillator circuit wherein the load current applied to animal tissue treatment electrodes is fed back to the transistor. Removal of load is sensed to automatically remove feedback and stop oscillations. A thermistor on one treatment electrode senses temperature, and by means of a control circuit controls oscillator transistor current.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 36326, 36985, 36996, 37018, 37212, 37217, 37230, 37231, 37232, 37236

37186 (BNL—28300) **Pigment-protein complexes.** Siegelman, H.W. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 3p. (CONF-800963—2). NTIS, PC A03/MF A01.

From 5. international photosynthesis congress; Kassandra-Halkidiki, Greece (7 Sep 1980).

The photosynthetically-active pigment protein complexes of procaryotes and eucaryotes include chlorophyll proteins, carotenochlorophyll proteins, and biliproteins. They are either integral components or attached to photosynthetic membranes. Detergents are frequently required to solubilize the pigment-protein complexes. The membrane localization and detergent solubilization strongly suggest that the pigment-protein complexes are bound to the membranes by hydrophobic interactions. Hydrophobic interactions of proteins are characterized by an increase in entropy. Their bonding energy is directly related to temperature and ionic strength. Hydrophobic-interaction chromatography, a relatively new separation procedure, can furnish an important method for the purification of pigment-protein complexes. Phycobilisome purification and properties provide an example of the need to maintain hydrophobic interactions to preserve structure and function.

37187 ATP synthesis by Ca^{2+} + Mg^{2+} - ATPase in detergent solution at constant Ca^{2+} levels. Ratkje, S.K.; Shamoo, A.E. (Univ. of Rochester, NY). *Biophys. J.;* **30**: No. 3, 523-530(Jun 1980).

ATP has been synthesized by the purified Ca^{2+} + Mg^{2+}-dependent ATPase from sarcoplasmic reticulum (SR) solubilized in nonionic detergent dodecyloctaoxyethylenglycolmonoether in a solution containing inorganic phosphate and glycerol by changing pH upon addition of ADP. The Ca^{2+} concentration is kept constant during the experiment. Optimum synthesis is found at $CaCl_2$ = 0.6 mM and the ΔpH = 2.9 +- 0.2. The enzyme has been digested by trypsin for 1 and 20 min, and it is found that synthesis of ATP is correlated with the Ca^{2+}-uptake into SR. The data indicate that the enzyme alone is responsible for active transport of Ca^{2+} in SR. The driving force for the ATP synthesis of the process may be due to various ion-protein interactions. H^+ cannot substitute for Ca^{2+} in the synthesis of ATP but acts probably through a modification of the Ca^{2+} binding sites. The data give support that the integrity of the enzyme molecule between its hydrolytic site and the Ca^{2+}-binding sites is essential for the overall Ca^{2+} transport.

37188 Ethylene action and loss of membrane integrity during petal senescence in Tradescantia. Suttle, J.; Kende, H. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiol.;* **65**: No. 6, 1067-1072(Jun 1980).

Senescence of isolated petals of Tradescantia is accompanied by a large increase in membrane permeability, and application of ethylene hastens the onset of this increase. There is a 1- to 2.5-hour lag between ethylene application and the onset of anthocyanin efflux (an indicator of increased membrane permeability). Simultaneous application of 0.1 millimolar cordycepin or cycloheximide with ethylene abolishes the response to ethylene. Analysis of phospholipid levels in these petals during senescence has shown that the increase in membrane permeability is accompanied by a massive loss of phospholipids. Factors which enhance or retard the rate of anthocyanin efflux exert a corresponding effect on the rate of phospholipid loss. The composition of the phospholipid fraction remains unchanged during senescence. The activity of phospholipase D declines during senescence whereas that of acyl hydrolase remains essentially constant.

37189 Water vapor conductance and CO_2 uptake for leaves of a C_4 desert grass, Hilaria rigida. Nobel, P.S. (Univ. of California, Los Angeles). Contract DE-AM03-76-SF00012. *Ecology;* **61**: No. 2, 252-258(Apr 1980).

Availability of soil water was the major influence on seasonal stomatal activity of Hilaria rigida (Thurb.) Benth. ex Scibn. over a 2-yr study period in the Colorado desert section of the Sonoran desert. Major stomatal opening (water vapor conductance >2 mm/s) occurred for 4.6 mo in the relatively cool winter-spring (maximum daytime temperatures averaging 17°C) and for 1.7 mo in the late summer-early fall (maximum daytime temperature averaging 31°C). The temperature optimum for CO_2 uptake was generally above daytime temperatures, particularly in the winter. When the daytime growth temperature was raised from 16° to 49°C in laboratory experiments, the temperature optimum for CO_2 uptake shifted from 29° to 43°C. Besides the rather high temperature optimum for CO_2 uptake, H. rigida displayed other typical C_4 characteristics including Kranz anatomy, a low CO_2 compensation point (12 μ1/1), and a lack of light saturation of CO_2 uptake at full sunlight. Under optimal field conditions, the CO_2 uptake rate can be 67 $\mu mol.m^{-2}.s^{-1}$ (106 mg $CO_2.dm^{-2}.h^{-1}$), higher than has been reported for any other species. The accompanying high water use efficiency (mass CO_2 taken up by leaf blades/mass H_2O lost) may help explain the success of this hardy grass in both the Mojave and Sonoran deserts.

37190 Synthesis of amino acids. Davis, J.W. Jr. (to Dept. of Energy). US Patent Application 077,811. 21 Sep 1979. 14p.

A method is described for synthesizing amino acids preceding through novel intermediates of the formulas: $R_1R_2C(OSOC1)CN$, $R_1R_2C(C1)CN$ and $[R_1R_2C(CN)O]_2SO$ wherein R_1 and R_2 are each selected from hydrogen and monovalent hydrocarbon radicals of 1 to 10 carbon atoms. The use of these intermediates allows the synthesis steps to be exothermic and results in an overall synthesis method which is faster than the synthesis methods of the prior art.

37191 Intracellular localization of β-aspartate kinase in spinach (Spinacea oleracea). Wahnbaeck-Spencer, R.; Mills, W.R.; Henke, R.R.; Burdge, E.L.; Wilson, K.G. (Comparative Animal Research Lab., Oak Ridge, TN). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **104**: No. 2, 303-308(Aug 1979).

β-Aspartate kinase is a key regulatory enzyme catalyzing the first step in the aspartate pathway leading to the synthesis of lysine, threonine and methionine. As such, its presence in a particular cellular compartment or organelle would suggest that control of the aspartate pathway resides in that organelle. The present work reports results of initial efforts to demonstrate the presence of β-aspartate kinase (ATP: L-aspartate 4 phosphotransferase, EC 2.7.2.4) in organelle preparations from spinach leaf tissues.

37192 Photosynthetic vesicles with bound phycobilisomes from Anabaena variabilis. Katoh, T.; Gantt, E. (Smithsonian Inst., Rockville, MD). *Biochim. Biophys. Acta;* **546**: 383-393(1979).

Photosynthetically active vesicles with attached phycobilisomes from Anabaena variabilis, were isolated and shown to transfer excitation energy from phycobiliproteins to F696 chlorophyll (Photosystem II). The best results were obtained when cells were disrupted in a sucrose/phosphate/citrate mixture (0.3:0.5:0.3 M, respectively) containing 1.5% serum albumin. The vesicles showed a phycocyanin/chlorophyll ratio essentially identical to that of whole cells, and oxygen evolution rates of 250 μmol; O_2/h per mg chlorophyll (with 4 mM ferricyanide added as oxidant), whereas whole cells had rates of up to 450. Excitation of the vesicles by 600 nm light produced fluorescence peaks (-196°C) at 644, 662, 685, 695, and 730 nm. On aging of the vesicles, or upon dilution, the fluorescence yield of the 695 nm emission peak gradually decreased with an accompanying increase and final predominant peak at 685 nm. This shift was accompanied by a decrease in the quantum efficiency of Photosystem II activity from an initial 0.05 to as low as 0.01 mol O_2/einstein (605 nm), with a lesser change in the V/sub max/ values. The decrease in the quantum efficiency is mainly attributed to excitation uncoupling between phycobilisomes and Photosystem II. It is concluded that the F685 nm emission peak, often exclusively attributed to Photosystem II chlorophyll, arises from more than one component with phycobilisome emission being a major contributor. Vesicles from which phycobilisomes had been removed, as verified by electron microscopy and spectroscopy, had an almost negligible emission at 685 nm.

37193 Electrophoretic isolation and partial characterization of three chlorophyll-protein complexes from blue-green algae. Reinman, S.; Thornber, J.P. (Univ. of California, Los Angeles). *Biochim. Biophys. Acta;* **547**: 188-197(1979).

Three chlorophyll-protein complexes have been resolved from blue-green algae using an improved procedure for membrane solubilization and electrophoretic fractionation. One complex has a red absorbance maximum of 676 nm and a molecular weight equivalency of 255,000 +- 15,000. A second complex has an absorbance maximum of 676 nm, a molecular weight equivalency of 118,00 +- 8000, and resembles the previously described P-700-chlorophyll a-protein (CPI) of higher plants and algae. The third chlorophyll-protein has a red absorbance maximum of 671 nm and a molecular weight equivalency of 58,000 +- 5000. Blue-green algal membrane fractions enriched in Photosystem I and heterocyst cells do not contain this third chlorophyll-protein, whereas Photosystem II-enriched membrane fractions and vegetative cells do. A component of the same spectral characteristics and molecular weight equivalency was also observed in chlorophyll b-deficient mutants of barley and

maize. It is hypothesized that this third complex is involved in some manner with Photosystem II.

37194 Purification and physiochemical properties of limited proteolysis products of T4 helix destabilizing protein (gene 32 protein). Hosoda, J.; Moise, H. (Univ. of California, Berkeley). *J. Biol. Chem.;* **253**: No. 20, 7547-7555(25 Oct 1978).

Limited proteolysis of T4 helix destabilizing protein (gene 32 protein = gp32) produced three stable products, gp32*I, gp32*II, and gp32*III. Gp32*I and gp32*II produced by chymotrypsin digestion were purified by duplex DNA-cellulose column chromatography and their amino acid compositions, NH_2-terminal sequences, and isoelectric points were compared with those of the undigested gp32. Results indicated that removal of an acidic region (A) from the COOH-terminal of gp32 produced gp32*I. Removal of a basic region (B) from the NH-terminal of gp32*I produced gp32*III. In previous experiments with poly[d(A-T)] we have shown that gp32*I was a stronger helix destabilizer than gp32. With the removal of A-region, the kinetic block in melting of naturally occurring double-stranded DNA observed with gp32 seems to be eliminated. In the presence of gp32*I the temperature at the midpoint of the helix-coil transition of T4 DNA was lowered over 70°C at 12 mM ($Na^+ + K^+$) and 56°C at 102 mM ($Na^+ + K^+$). No extensive melting of T4 DNA was observed in the presence of gp32 before thermal denaturation of the protein occurred. With 10 mM Mg^{2+} ion the helix-coil transition of T4 DNA in the presence of gp32*I was reversible. Proteolytic digestion of mMg32 bound to single-stranded DNA indicated that the NH_2-terminal is inside of the complex because it is protected from proteolytic enzymes while the COOH-terminal is outside because it is as or more vulnerable to proteases than when in unbound gp32.

37195 Molecular orientation of bacteriorhodopsin within the purple membrane of Halobacterium halobium. Hayward, S.B. (Univ. of California, Berkeley); Grano, D.A.; Glaeser, R.M.; Fisher, K.A. *Proc. Natl. Acad. Sci. U.S.A.;* **75**: No. 9, 4320-4324(Sep 1978).

The direction of orientation of the protein bacteriorhodopsin within the purple membrane of Halobacterium halobium has been determined by selected-area electron diffraction of membranes preferentially oriented by adsorption to polylysine. Purple membrane is known to adsorb preferentially to polylysine by its cytoplasmic surface at neutral pH and by its extracellular surface at low pH. To maintain the adsorbed membranes in a well-ordered state in the electron microscope, an improved technique of preparing frozen specimens was developed. Large areas of frozen-hydrated specimens, devoid of bulk water, were obtainable after the specimen was passed through a Ca stearate film at an air-water interface. High-resolution microscopy was used to relate the orientation observed in the electron diffraction patterns to the orientation of the projected structure that is obtained from images. We have found that the three-dimensional structure determined by Henderson and Unwin is oriented with the cytoplasmic side uppermost - i.e., the helices fan outward on the cytoplasmic side of the membrane.

37196 Substrate utilization kinetic model for biological treatment processes. Chen, Y.R.; Hashimoto, A.G.; Hruska, R.L. Clay Center, NE; Department of Agriculture (1978). 24p. (NP—25116).

The applicability of Contois' kinetic equation to aerobic and anaerobic treatments of organic wastes is investigated. A refractory coefficient to account for non-biodegradable portion of the organic substrates in the digester is incorporated into the kinetic equation. The kinetic equation is applied to the data for aerobic digestions of organic substrates and for anaerobic treatment of dairy wastes. They all show very good fit of the kinetic equation to the data. Furthermore, the kinetic parameters and the refractory coefficients are shown to be independent of influent organic substrate concentration. This study confirms previous reports that the effluent quality of biological treatment systems for organic wastes depends on influent organic waste concentration. The effect of temperature on the kinetic parameters and the refractory coefficient for anaerobic treatment of sewage sludge is studied. It shows that the kinetic parameters vary with temperature, while the refractory coefficient remains fairly constant. Equations to predict biodegradable treatment efficiency and volumetric substrate utilization rate are also briefly discussed.

37197 Hot-symbiont interactions. III. Purification and partial characterization of Rhizobium lipopolysaccharides. Carlson, R.W.; Sanders, R.E.; Napoli, C.; Albersheim, P. (Univ. of Colorado, Boulder). Contract EY-76-S-02-1426. *Plant Physiol.;* **62**: 912-917(1978).

The lipopolysaccharides of three strains each of Rhizobium leguminosarum, R. phasecoli, and R. trifolii have been purified and partially characterized. The last step in the purification procedure is gel filtration column chromatography using Sepharose 4B with the elution buffer consisting of ethylenediaminetetraacetic acid and triethylamine. Each of the lipopolysaccharides reported in this paper elutes as a symmetrical peak in the partially included volume of this Sepharose 4B column. The ration of 2-keto-3-deoxyoctonate acid (a sugar which is characteristic of lipopolysaccharides) to hexose is constant throughout the carbohydrate-containing peaks as they elute from the Sepharose 4B. The compositions and immunodominant structures of the purified lipopolysaccharides vary as much among strains of a single Rhizobium species as among the different species of Rhizobium. There is no obvious correlation between the nodulation group to which a Rhizobium belongs and the chemical composition or immunochemistry of the Rhizobium's lipopolysaccharide. There is extensive crosslysis by phage of strains of R. trifolii, R. phaseoli, and R. leguminosarum. This suggests that the receptors for these cross-lysing phage reside either in nonlipopolysaccharide structures or in common structures within the lipopolysaccharide which are not detected by compositional or immunochemical analysis.

37198 Primary photochemical processes in isolated reaction centers of Rhodopseudomonas viridis. Holten, D. (Washington State Univ., Pullman); Windsor, M.W.; Parson, W.W.; Thornber, J.P. *Biochim. Biophys. Acta;* **501**: 112-126(1978).

Picosecond and nanosecond spectroscopic techniques have been used to study the primary electron transfer processes in reaction centers isolated from the photosynthetic bacterium Rhodopseudomanas viridis. Following flash excitation, the first excited singlet state (P*) of the bacteriochlorophyll complex (P) transfers an electron to an intermediate acceptor (I) in less than 20 ps. The radical pair state (P^+I^-) subsequently transfers an electron to another acceptor (X) in about 230 ps. There is an additional step of unknown significance exhibiting 35 ps kinetics. P^+ subsequently extracts an electron from a cytochrome, with a time constant of about 270 ns. At low redox potential (X reduced before the flash), the state P^+I^- (or P/sup F/) lives approx. 15 ns. It decays, in part, into a longer lived state (P/sup R/), which appears to be a triplet state. State P/sup R/ decays with an exponential time of approx. 77 μs. After continuous illumination at low redox potential (I and X both reduced), excitation with an 8-ps flash produces absorption changes reflecting the formation of the first excited singlet state, P*. Most of P* then decays with a time constant of 20 ps. The spectra of the absorbance changes associated with the conversion of P to P* or P^+ support the view that P involves two or more interacting bacteriochlorophylls. The absorbance changes associated with the reduction of I to I^- suggest that I is a bacteriopheophytin interacting strongly with one or more bacteriochlorophylls in the reaction center.

37199 Endogenous RNA-bound RNA-dependent DNA polymerase activity in Neurospora crassa. Dutta, S.K. (Howard Univ., Washington, DC); Beljanski, M.; Bourgarel, P. Contract E(40-1) 4182. *Exp. Mycol.;* **1**: 173-182(1977).

Evidence indicating the presence of a RNA-bound RNA-dependent DNA polymerase (RDDP) in the eukaryotic fungus Neurospora crassa is presented. This enzyme, free of DNA-dependent DNA polymerase, is capable of synthesizing DNA only in the presence of all four deoxyribonucleoside 5'-triphosphates and Mg^{2+}. The DNA polymerase activity is decreased considerably if the RNA bound to the enzyme is eliminated. The activity can be restored by addition of some particular RNA but not by addition of DNA. Both template RNA and the synthesized DNA product sedimented on sucrose density gradients at approximately 6 S. RNA-bound RNA-dependent DNA polymerase partially purified from extracts of N. crassa was distinguishable from known DNA-dependent DNA polymerases. DNA synthesized by RDDP was acid-precipitable and complementary to enzyme-bound RNA.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 37208, 37213, 37227

37200 ^{13}N, ^{15}N isotope and kinetic evidence against hyponitrite as an intermediate in denitrification. Hollocher, T.C. (Brandeis Univ., Waltham, MA); Garber, E.; Cooper, A.J.L.; Reiman, R.E. Contract EE-77-5-02-4268-7. *J. Biol. Chem.;* **255**: No. 11, 5027-5030(10 Jun 1980).

^{13}N- and ^{15}N-labeling experiments were carried out with Paracoccus denitrificans, grown anaerobically on nitrate, to determine whether hyponitrite might be an obligatory intermediate in denitrification and a precursor of nitrous oxide. From experiments designed to trap [^{13}N]- or [^{15}N, ^{15}N]hyponitrite by dilution into authentic hyponitrite it was calculated that the intracellular concentration of a presumptive hyponitrite pool must be less than 0.4 mm. In order for a pool of this size to turn over rapidly enough to handle the flux of nitrogen during denitrification, the spontaneous rate of hyponitrite dehydration must be enhanced by a factor of several thousand through enzyme catalysis. Cell extracts failed to catalyze this reaction under a variety of conditions. It is concluded that hyponitrite cannot be an intermediate in denitrification. In addition, the assimilation of inorganic nitrogen was studied in P. dentrificans using ^{13}N as tracer. At low concentrations ($<10^{-8}$ M) of labeled nitrate and nitrite 5 to 10% of the label was assimilated into non-volatile metabolites and 90 to 95% was reduced to N_2. Similarly, with 15 mm [^{13}N]nitrate, 5% of the label went into metabolites and 95% to N_2. High pressure liquid chromatography analysis of the

labeled metabolites indicated that the major pathway for assimilation of inorganic nitrogen in P. denitrificans under these conditions is through ammonia incorporation via the aspartase reaction.

37201 Effect of ATPase inhibitors on cell potential and K^+ influx in corn roots. Cheeseman, J.M.; LaFayette, P.R.; Gronewald, J.W.; Hanson, J.B. (Univ. of Illinois, Urbana). Contract EY 76-S-02-0790. *Plant Physiol.;* **65**: No. 6, 1139-1145(Jun 1980).

Experiments were performed to determine the effect of plasmalemma ATPase inhibitors on cell potentials (psi) and K^+ (^{86}Rb) influx of corn root tissue over a wide range of K^+ activity. N,N'Dicyclohexylcarbodiimide (DCCD), oligomycin, and diethylstilbestrol (DES) pretreatment greatly reduced active K^+ influx and depolarized psi at low, but not at high, K^+ activity (K^0). More comprehensive studies with DCCD and anoxia showed nearly complete inhibition of the active component of K^+ influx over a wide range of K^0, with no effect on the apparent permeability constant. DCCD had no effect on the electrogenic component of the cell potential (psi/sub p/) above 0.2 millimolar K^0. Net proton efflux was rapidly reduced 80 to 90% by DCCD. Since tissue ATP content and respiration were only slightly affected by the DCCD-pretreatment, the inhibitions of active K^+ influx and psi/sub p/ at low K^0 can be attributed to inhibition of the plasmalemma ATPase. It is concluded that by DCCD treatment, the energy-linked electrogenic system at high K^0 is separated from the energy-linked K^+ influx system at low K^0. The results are analyzed in terms of electrical analogue models of the membrane. The presence of two, algebraically additive electrogenic components is indicated; one is better modeled as a current source (system I) and one as a voltage source (system II). No K^+ stimulationof system II is required to produce the observed K^0 dependence of psi/sub p/.

37202 Cleavage and adsorption of parathyroid hormone at high dilution: implications for receptor binding studies. Barrett, P.Q.; Neuman, W.F. (Univ. of Rochester, NY). *Biochim. Biophys. Acta;* **541**: 223-233(1978).

Like other polypeptide hormones, purified intact parathyroid hormone (1 to 84) parathyroid hormone is notoriously unstable and is subject to large adsorptive losses in routine laboratory manipulation. The present studies were undertaken with ^{125}I-labeled hormone to quantitate the problem and to develop preventative measures, particularly with concentrations of physiological interest, $1 \cdot 10^{-10}$ M. It was found that spontaneous cleaveage of the hormone takes place upon its incubation in air or oxygen. This can be prevented by the presence of mercaptoethanol or by plasma levels of cysteine and ascorbate. Under non-cleaveage conditions, adsorption was found to be extensive on all materials tested. This adsorption increased with time up to 2h, was independent of ionic strength, increased with increasing temperature and was presumed to involve hydrophobic interactions. Under given conditions, adsorption was proportional to concentration (constant percentage). However, at very high concentrations, $1 \cdot 10^{-6}$ M, adsorption was markedly reduced. Adsorption was minimized at low pH (2). Bovine serum albumin reduced adsorption under all conditions when present at concentrations of 2 mg/ml or more. Coating laboratory ware with cetyl alcohol also was helpful. Using optimal conditions, cleavage is prevented and losses are less than 5% at neutral pH, and under 2% at pH 2.

CYTOLOGY

REFER ALSO TO CITATION(S) 37188, 37191, 37199, 37218, 37231, 37232

37203 Parabolic cell analyzer. Salzman, G.C.; Hagenson, M.J.S. (to Dept. of Energy). US Patent 4,200,802. 29 Apr 1980. Filed date 28 Mar 1979. 4p.

PAT-APPL-24,762.

The disclosure is directed to a cell analysis apparatus incorporating a paraboloidal cavity for maximum utilization for improved cell characteristic monitoring.

37204 Development of a culture medium for growing Xeopus laevis oocytes. Wallace, R.A.; Misulovin, Z.; Jared, D.W.; Wiley, H.S. (Oak Ridge National Lab., TN). *Gamete Res.;* No. 1, 269-280(1978).

A defined medium for growing defolliculated Xenopus laevis oocytes was developed by monitoring vitellogenin incorporation. Optimum conditions were acheived by use of 50% Liebovitz L-15 medium supplemented with 1 mM L-glutamine, 15 mM Hepes, 5 mg/ml vitellogenin, and 1 μg/ml insulin (final pH = 7.8). Stage IV/V oocytes remained morphologically normal in this medium for at least two weeks and grew at an average rate of 0.25 mm^3 per week. This is the first time defolliculated Xenopus laevis oocytes have been grown in vitro.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 37224

METABOLISM

REFER ALSO TO CITATION(S) 37240

37205 Magnesium-phosphorus interrelations in man. Spencer, H.; Kramer, L.; Gatza, C.; Norris, C.; Coffey, J. (Veterans Administration Medical Center, Hines, IL). pp 401-407 of Trace substances in environmental health. XIII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1979).

From 13. annual conference on trace substances in environmental health; Columbia, MO, USA (4 Jun 1979).

The effect of phosphorus on magnesium metabolism was studied in adult men receiving different calcium intakes ranging from 200-2000 mg/day. The diet and urinary and fecal excretions were analyzed for Mg, P and Ca. In control studies the dietary P intake was 800 mg/day and in experimental studies 2000 mg/day due to the addition of glycerophosphate. The dietary Mg intake was 250 mg/day in control studies and 850 mg/day in the high Mg studies due to addition of magnesium oxide. Increasing the P intake during 200, 1400 and 2000 mg Ca intakes did not affect urinary or fecal Mg excretions during a low Mg intake. However, during a high Mg intake, the high P intake was associated with increased fecal Mg while urinary Mg decreased. Increasing the Mg intake increased fecal P slightly and decreased urinary P excretion in some cases.

MEDICINE

37206 Corneal-shaping electrode. Doss, J.D.; Hutson, R.L. (to Dept. of Energy). US Patent Application 909,865. 26 May 1978. 13p.

The disclosure relates to a circulating saline electrode for changing corneal shape in the eyes of animals. The electrode comprises a tubular nonconductive electrode housing having an annular expanded base which has a surface substantially matched to the subject animal's corneal surface. A tubular conductive electrode connected to a radiofrequency generating source is disposed within the electrode housing and longitudinally aligned therewith. The electrode has a generally hemispherical head having at least one orifice. Saline solution is circulated through the apparatus and over the cornea to cool the corneal surface while radiofrequency electric current emitted from the electrode flows therefrom through the cornea to a second electrode, on the rear of the animal's head. This current heats the deep corneal stroma and thereby effects corneal reshaping as a biological response to the heat.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 37227

37207 (CONF-780110—, pp 272-282) **Energy response requirements for exposure meters used in diagnostic radiology.** Horn, B.A.; Randall, M.G. (Southern California Permanente Medical Group, Los Angeles). 1978.

From 11. symposium on radiation instrumentation; San Diego, CA, USA (17 Jan 1978).

When measurements of exposure and half-value layer are required for primary medical x-ray beams, the energy response of the measuring instrument is an important consideration. Using a computer the energy response to polyenergetic x-rays was simulated for several commercially available exposure meters. The magnitude of errors due to energy response, when measuring exposure and half-value layer, will be discussed for x-ray beams in the diagnostic energy range (including mammography). Energy response requirements for desired accuracy will also be presented.

37208 Fluorinated glucose analog, 2-fluoro-2-deoxy-D-glucose (F-18): nontoxic tracer for rapid tumor detection. Som, P.; Atkins, H.L.; Bandoypadhyay, D. (Brookhaven National Lab., Upton, NY). *J. Nucl. Med.;* **21**: No. 7, 670-675(Jul 1980).

Rapid uptake of F-18 FDG was observed in a variety of transplanted and spontaneous tumors in animals. The tumor uptake reached a peak by 30 min and remained relatively constant up to 60 min, with a very slow wash-out of F-18 activity from the tumor thereafter. Tumor-to-normal tissue and tumor-to-blood ratios ranged from 2.10 to 9.15 and 2.61 to 17.82, respectively, depending on the type of tumor. A scintiscan of a seminoma in a dog showed very high uptake in the viable part and lack of uptake in the necrotic mass. Toxicological studies in mice using 1000 times human tracer dose (HTD) per week for 3 weeks and in dogs using 50 times HTD per week for 3 weeks did not show any evidence of acute or chronic toxicity.

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 37210, 37218

37209 Comparison of microdosimetric measurements with spherical proportional counters and solid-state detectors. Dicello, J.F.; Amols, H.I.; Zaider, M.; Tripard, G. (Los Alamos Scientific Lab., NM). *Radiat. Res.;* **82**: No. 3, 441-453(Jun 1980).

Microdosimetric spectra for range-modulated negative pion beams have been measured by two methods. Data were obtained with a Rossi-type tissue-equivalent spherical proportional counter of 1.3 cm radius and at an equivalent diameter of 2 μm in unit density tissue. Corresponding measurements were performed with a 7-μm-thick, 0.1-cm-radius lithium-drifted silicon detector. A comparison is warranted since both techniques are being used in clinical trials to characterize the radiation quality of the beams. A comparison of the results shows significant differences in both the absolute magnitudes and shapes of the lineal energy spectra. Monte Carlo calculations indicate that these differences result primarily from the different diameters of the two detectors as well as from their different thicknesses. Attempts to unfold LET distributions from the silicon detector data using conventional algorithms prove unsatisfactory because of the large fraction of events from particles which start or stop in the detector. The relative merits of the two techniques are discussed in relation to the present use of both methods in connection with therapeutic programs.

UNSEALED RADIONUCLIDES IN THERAPY

37210 5-(^{125}I)-iododeoxyuridine and the Auger effect: biological consequences and implications for therapy. Bloomer, W.D.; Adelstein, S.J. (Harvard Medical School, Boston, MA). *Pathobiol. Annu.;* **8**: 407-421(1978).

The development of a strategy for the treatment of cancer with internally administered radionuclides has two overriding constraints. The first is a biological one requiring the radiopharmaceutical to be incorporated preferentially within tumor cells or tumor cell targets in high enough concentration to be effective yet without causing irreparable damage to surrounding or critical normal tissues. The second is a physical one requiring the radionuclide to deposit its energy within a volume approximately that of the tumor cell or, if possible, confined to the radiosensitive targets of the tumor cell. Conceptually, as we shall explain below, this can be achieved by using the Auger effect from radionuclides decaying by electron capture. In many ways the physical and biological requisites for such an internally administered radiopharmaceutical are met by the thymidine analog 5-(^{125}I)-iododeoxyuridine (^{125}IUdR), in which the 5-methyl group of thymidine is replaced by ^{125}I. This substitution produces a compound which behaves remarkably like thymidine because both the methyl group and iodine have similar van der Waal's radii. As a result, the radioiodine deposits its energy within the sensitive structures of the cell. Consideration in this report will be limited to the biologic consequences and implications for therapy of ^{125}IUdR incorporated into DNA.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 37186, 37192, 37193, 37194, 37195, 37197, 37198, 37199, 37221

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 37200

MORPHOLOGY

REFER ALSO TO CITATION(S) 37152

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 37156, 37186, 37189, 37201, 37204, 37205, 37235

37211 (LMF—69, pp 166-171) **Immunochemical analysis of alveolar surface fluids obtained by bronchoalveolar lavage: effects of local immunization.** Hill, J.O.; Bice, D.E.; Harris, D.L.; Muggenburg, B.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Lavage fluids were obtained from Beagle dogs by serial bronchoalveolar lavage of immunized and control lung lobes 3-21 days after local deposition of sheep red blood cells. Concencentrated fluids were analyzed immunochemically for total protein, immunoglobulin G and M and specific antibody content. Immunized lobes usually contained more of all these effectors than did the contralateral control lobes. Left apical immunization induced significant differences in these parameters between immunized and control lobes; right apical immunization rarely did. Although most of the total protein (46 to 92% albumin, 11 to 25% IgG) was derived from the serum, the specific antibody appeared in the lavage fluid predominantly as a result of local production by cells in the lung. These results indicate that individual lung lobes may respond semi-independently.

37212 Corticotropin responsiveness in the neonatal rat. Guillet, R.; Michaelson, S.M. (Univ. of Rochester, NY). *Neuroendocrinology;* **27**: 119-125(1978).

Plasma ACTH concentrations were determined in neonatal rats 1, 7, 14, and 21 days old, subjected to treatment with either a median eminence extract with corticotropin releasing factor (CRF) activity or to ether exposure. CRF injection elevated plasma ACTH levels on all days tested. Ether exposure elevated ACTH levels on days 14 and 21, but not on days 1 or 7. These results indicate: (1) that there is no diminution of responsiveness of the pituitary to direct stimulation by CRF as a function of age, and (2) that the mediators of the stress response above the level of the pituitary are not functionally mature until approximately day 14. Correlations with previous studies also indicate that there is a delay in the return of adrenal responsiveness until some time after these mediators attain maturity.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 36011

37213 Studies on the crystalline lens. XXVI. Kinetic study showing saturation of the sodium pump. Kinsey, V.E.; Hightower, K.R. (Oakland Univ., Rochester, MN). *Invest. Ophthal. Visual Sci.;* **17**: No. 2, 186-190(Feb 1978).

Active transport of sodium out of rabbit lenses was shown to be carrier mediated by observing the dependence of efflux of ^{22}Na on intracellular concentration of nonlabeled sodium which previously was elevated by incubating lenses at 0° C. Velocity of sodium efflux increased asymptotically with increasing concentration of intracellular sodium, demonstrating saturation of the carrier. The maximum velocity of the sodium pump based on Michaelis-Menten kinetics was found to be 4.6 μmol/hr/lens, and the half-saturation of the carrier, which appeared to involve a single site, occured at 36 mM.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 37238

37214 Mortality in areas surrounding the Savannah River Plant. Sauer, H.I. (Univ. of Missouri, Columbia). pp 28-36 of Trace substances in environmental health. XIII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1979).

From 13. annual conference on trace substances in environmental health; Columbia, MO, USA (4 Jun 1979).

The Southeastern coastal plain has been shown to have very high death rates for middle-aged white males prior to opening the Savannah River Plant (SRP) in early 1955 as well as since. Located near Augusta, GA, SRP is reported to emit low levels of radiation, similar to a nuclear power plant. Is living close to SRP associated with an increased risk of death for radiation-associated causes, after 20 years of operation? From death detail tapes of the National Center for Health Statistics for 1973-1976 and earlier periods and Census population data, we have calculated cause-age-sex-race-specific rates. No consistent, statistically significant excesses or deficits in deaths have been identified for areas close to SRP, as compared with those more distant. Cancer rates are low in comparison with high rates for the cardiovascular diseases. Further study is needed on the causes of the high rates.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 37201, 37222

37215 Nitrogen mineralization, immobilization, and nitrification following urea fertilization of a forest soil under field and laboratory conditions. Johnson, D.W.; Edwards, N.T.; Todd, D.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Soil Sci. Soc. Am. J.;* **44**: No. 3, 610-616(May 1980).

Following a 200-kg urea-N/ha fertilization in a loblolly pine stand (Pinus taeda), soil mineral N levels (almost entirely NH_4^+) declined from 200 ppM 20 days after fertilization to < 10 ppM within 161 days. Similar patterns had been previously observed

following urea fertilization in a Douglas-fir stand. After the decline in soil mineral N, 20% (40 ppM) of fertilizer N was mineralized within 4 weeks of aerobic incubation in the laboratory at 25°C. Nitrogen mineralization in control soils did not occur after 7 weeks incubation.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

RADIATION EFFECTS ON BIOCHEMICALS

37216 Inelastic electron tunneling study of UV radiation damage in surface adsorbed nucleotides. Clark, J.M.; Coleman, R.V. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). *J. Chem. Phys.;* **73**: No. 5, 2156-2178(1 Sep 1980).

Ultraviolet radiation damage to nucleotides has been studied using inelastic electron tunneling (IETS) to monitor the direct bond damage as reflected in the vibrational mode intensity. The damage rate is found to be directly correlated to the resonance energy per π electron of the purine or pyrimidine base residue. Low lying ring modes are damaged most rapidly while modes associated with CH components are less rapidly damaged. The mononucleotides are damaged more rapidly than the corresponding bases, but no cleaving of the glycodidic bond between the base and sugar is observed. In the case of the purine base nucleotides double bond structure develops during UV exposure and is attributed to the more complex damage sequence of the base ring. The nucleotides are adsorbed on the alumina barrier of an Al—AlO/sub x/—Pb tunnel junction and the PO^-_2 group interacts with the surface. The majority of the other vibrational modes are unperturbed and indicate that the sugar and base rings form a complex on the surface of relatively fixed orientation. The IETS spectra of all nucleotides indicate a similar surface adsorption and this is not influenced by variation of the substrate temperature as is the case for molecules with a less constrained surface orientation. This unique surface configuration is discussed along with comparison to other molecules where temperature effects on the IETS spectrum are strong. Preliminary results of UV damage to polynucleotides and polypeptides is also reported. The role of the alumina surface structure and interaction with respect to the different types of molecules is also discussed.

IN VITRO

REFER ALSO TO CITATION(S) 37219

37217 Does oxygen enhance the radiation-induced inactivation of penicillinase. Samuni, A.; Kalkstein, A.; Czapski, G. (Hebrew Univ., Jerusalem, Israel). Contract EY(11-1)-3221. *Radiat. Res.;* **82**: No. 1, 65-73(Apr 1980).

The radiation-induced inactivation of penicillinase (β-lactamase, EC 3.5.2.6) in dilute aqueous solutions buffered with phosphate was studied by examining enzyme radiosensitivity in the presence of various gases (He, O_2, H_2, N_2O and $N_2O + O_2$). The introduction of either N_2O or O_2 was found to reduce the radiodamage. On the other hand, H_2 or $N_2O + O_2$ gas mixture enhanced the radiosensitivity. In the presence of formate and oxygen no enzyme inactivation was detected. The results indicated that the specific damaging efficiency of H atoms is more than twofold higher than that of OH radicals; therefore, in 50 mM phosphate buffer, where more than half the free radicals are H atoms, the H radicals are responsible for the majority of the damage. The superoxide radicals appeared to be completely inactive and did not contribute to enzyme inactivation. Oxygen affected the radiosensitivity in two ways: (1) it protected by converting e/sub aq/$^-$ and H into harmless O_2-radicals; and (2) it increased inactivation by enhancing the damage brought about by OH radicals (OER = 2.6). In oxygenated buffer the protection effect of oxygen exceeded that of sensitization, thus giving rise to a moderate overall protection effect.

IN ANIMALS

REFER ALSO TO CITATION(S) 36266

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

37218 In vivo cell survival and volume response characteristics of rat rhabdomyosarcoma tumors irradiated in the extended peak region of carbon- and neon-ion beams. Tenforde, T.S.; Curtis, S.B.; Crabtree, K.E.; Tenforde, S.D.; Schilling, W.A.; Howard, J.; Lyman, J.T. (Univ. of California, Berkeley). *Radiat. Res.;* **83**: No. 1, 42-56(Jul 1980).

Cell survival was measured for rat rhabdomyosarcoma R1 tumors irradiated in the distal 4-cm peak region of 400 MeV/u carbon- and neon-ion beams. An in vitro assay for clonogenic capacity was used to determine the surviing fraction of cells following in vivo tumor irradiation. Based on the response to 225-kV x rays under air-breathing and hypoxic conditions, it was estimated that the chronically hypoxic fraction of cells is 35%. From survival curves for tumors irradiated in air-breathing rats, $RBE_{0.1}$ values determined at the 10% survival level were 2.0 and 3.1 for the peak carbon- and neon-ion radiation, respectively. Under hypoxic conditions, $RBE_{0.1}$ values for peak carbon and neon ions were, respectively, 2.0 and 3.3 A diminshed oxygen effect was observed for the neon-ion relative to the carbon-ion radiation. Values of RBE for the two heavy charged-particle beams were also determined from measurements of tumor regression and regrowth following irradiation. Based on the ratio of x-ray to charged-particle doses required to produe a growth delay of 50 days, RBE_{50} values for peak carbon and neon ions were 2.3 and 2.9, respectively. These RBE values are similar to those obtained in the cell survival studies and, to the extent that they reflect a large population of hypoxic cells, indicate that peak neon ions have a greater therapeutic potential than peak carbon ions for the treatment of radioresistant hypoxic tumors.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

37219 (DOE/EV/03408—28) **Three year progress report and renewal request.** Powers, E.L. (Texas Univ., Austin (USA). Lab. of Radiation Biology). Aug 1980. Contract AS05-76EV03408. 20p. NTIS, PC A02/MF A01.

A review of research accomplisments during the contract period is presented. Reported projects include: (1) metals as radiation sensitizers of spores; (2) studies on transforming and calf thymus DNA; (3) pulse radiolysis studies on DNA components; (4) studies of metal complexes of DNA compounds; and (5) dosimetry of the pulsed electron beam. (ACR)

37220 Photodynamic effects of dyes on bacteria. III. Mutagenesis by acridine orange and 500-nm monochromatic light in strains of Escherichia coli that differ in repair capability. Hass, B.S.; Webb, R.B. (Argonne National Lab., IL). *Mutat. Res.;* **60**: 1-11(1979).

In the presence of acridine orange (AO) and monochromatic 500-nm light, the recombination-deficient strain of Escherichia coli, WP10 (recA), showed a 15-fold increase in mutation rate over the wild-type (WP2) strain. Under the same conditions, strain B/sub s-1/ (uvrB lexA lon) showed a 5-fold increase in mutation rate over strain WP2. In contrast, the endonuclease-deficient strain, WP2s (uvrA), showed a lower AO-500 nm mutation rate than wild-type. The extremely high mutation rate of the recA strain cannot be due to error-prone inducible SOS repair since the inducible $recA^+$ function is absent. Repair of the AO-500 nm-induced lesions is likely due to a $recA^+$-dependent, error-free, recombination process. It is concluded that the high mutation rates with AO-500 nm light obtained in chemostat cultures of recA and lexA strains occur as a consequence of errors during semi-conservative DNA replication in the presence of unrepaired DNA lesions.

FOOD PRESERVATION

37221 Comparison of Herpes simplex virus plaque development after viral treatment with anti-DNA or antilipid agents. Coohill, T.P.; Babich, M.; Taylor, W.D.; Snipes, W. (Western Kentucky Univ., Bowling Green). *Biophys. J.;* **30**: No. 3, 517-521(Jun 1980).

The plaque development of Herpes simplex virus type 1 (HSV) is slower for viruses treated with two anti-DNA agents: ultraviolet radiation (uv) or n-acetoxy-2-acetyl-aminofluorene. For HSV treated with three antimembrane agents - butylated hydroxytoluene, acridine plus near uv radiation, or ether - the plaque development time is the same as for untreated viruses. These differences hold even for viruses that survived treatment that lowered viability below the 1% level. Gamma ray inactivation of HSV produces no change in plaque development even though this agent is believed to preferentially affect viral DNA.

VACCINE PREPARATION AND OTHER APPLICATIONS

37222 (SAND—80-7124C) **Effectiveness of irradiation in killing pathogens.** Yeager, J.G.; Ward, R.L. (Sandia National Labs., Albuquerque, NM (USA); BDM Corp., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 29p. (CONF-800964—2). NTIS, PC A03/MF A01.

From National symposium on the use of cesium-137 to process sludge for further reduction of pathogens; Denver, CO, USA (3 Sep 1980).

United States Environmental Protection Agency regulations include gamma ray irradiation of sludge as an approved Process to Further Reduce Pathogens (PFRP) prior to land application. Research at Sandia National Laboratories on pathogen inactivation in sludge by gamma irradiation has demonstrated that the 1 Mrad PFRP dose is capable, by itself, of eliminating bacterial, fungal, and parasitic pathogens from sludge. Gamma irradiation of sludge in conjunction with the required Processes to Significantly Reduce Pathogens (PSRP) should also eliminate the viral hazard from wastewater sludges.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 37214

VERTEBRATES

37223 (AD-A—079750/6) **Avenue to understanding the mechanism of radiation effects. extended serial sacrifice experimental methodology.** Neyman, J. (California Univ., Berkeley (USA). Statistical Lab.). Jan 1980. Contract N00014-75-C-0159. 20p. NTIS, PC A02/MF A01.

The visualized avenue towards understanding the mechanism of the effects of radiation on the health of animals used in the experiments is, primarily, through willing interested cooperation between experimenting biologists, on the one hand, and equally willing and interested mathematical statisticians on the other. A review of the developments over two recent decades leads the author to the following conclusions relating to experimental designs; (1) the design of survival experiments with serial sacrifices as proposed by Arther C. Upton is basic, but (2) This design needs an extension. The building of this extension depends very much on the inventiveness of experimenting biologists.

37224 **Proliferative response of type 2 lung epithelial cells after x rays and fission neutrons.** Meyer, K.R.; Witschi, H.; Ullrich, R.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Radiat. Res.;* **82**: No. 3, 559-569(Jun 1980).

A method has been developed for study of the type 2 epithelial cell population in situ in BALB/c mouse lung by measurement of the uptake of [^{14}C]thymidine into DNA of pulmonary cells after stimulation with the antioxidant butylated hydroxytoluene (BHT). Within 2 days of BHT injection there was a marked increase in total lung weight, total labeling index, and [^{14}C]thymidine incorporation. Autoradiographic procedures revealed that the proliferative response 2 days after BHT was due primarily to type 2 alveolar cells, which comprised 80% of the [^{3}H]thymidine-labeled lung cells at that time. Therefore it appeared that this system might provide a means of monitoring the type 2 cell population after irradiation. Radiation modified the BHT-induced proliferative response in a dose-dependent manner, but it did not alter the relative number of labeled cell types in the lung. Thus 2 days after mice were treated with irradiation and BHT, when the proliferative response was due to type 2 cells, [^{14}C]-thymidine incorporation and DNA levels in the lung were determined after various doses of 300-kVp x rays and fission neutrons. Dose-response curves were generated from these data, and the radiation response was characterized by the reciprocal of the slope of the exponential region of the curves, designated D_0(PF). When irradiation was followed immediately by the proliferative stimulus BHT, the D_0(PF) values were 120 rad for 300-kVp x rays and 60 rad for fission neutrons. Based on these D_0(PF) values, relative biological effectiveness of 2.0 was obtained.

MAN

REFER ALSO TO CITATION(S) 37210

NUCLIDE KINETICS AND TOXICOLOGY

MAN

37225 (UCD—472-503) **Deposition and clearance of inhaled aerosols.** Raabe, O.G. (California Univ., Davis (USA). Lab. for Energy-Related Health Research). 1979. Contract AC03-76SF00472. 63p. NTIS, PC A04/MF A01.

When aerosols are inhaled by man, different fractions of the inhaled materials are deposited by a variety of mechanisms in various locations in the respiratory tract. Particle size distribution, particle chemical properties, respiratory tract anatomy, and airflow patterns in the lung airways all influence the deposition. Subsequent to deposition, the inhaled material will be translocated by processes that depend on its character and site of deposition. Both deposition and retention play roles in determining the effects of inhaled particulate toxicants. In our modern society, virtually everyone is exposed occupationally, avocationally, or environmentally to a variety of dusts, fumes, sprays, mists, smoke, photochemical particles, and combustion aerosols. Particulate toxic aerosols, which may have detrimental effects on the lung, include asbestos, silica, metal fumes, infectious agents, pollen, acid mists, fibrous glass, tobacco smoke, insecticides, herbicides, organic carcinogens, and from the nuclear industry, radioactive aerosols. The particle size distribution and chemical and physical composition of airborne particulate material require special attention in evaluation of respiratory toxicology since a wide variability of physico-chemical properties may be encountered in both experimental and actual inhalation exposures. The essential features of the main factors affecting the mechanism of aerosol deposition and clearance are summarized. Selected references to available published works have been chosen to illustrate these factors rather than to serve as a complete bibliography. Although some supportive data from studies with experimental animals has been cited to illustrate basic phenomena, the emphasis is on deposition and clearance of potentially toxic particulate materials inhaled by people.

ANIMALS

REFER ALSO TO CITATION(S) 37026, 37208

37226 (UCRL—84213) **Transuranic concentrations in reef and pelagic fish from the Marshall Islands.** Noshkin, V.E.; Eagle, R.J.; Wong, K.M.; Jokela, T.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract W-7405-ENG-48. 24p. (CONF-801063—1). NTIS, PC A02/MF A01.

From International symposium on the impacts of radionuclide releases into the marine environment; Vienna, Austria (6 Oct 1980).

Concentrations of /sup 239 + 240/Pu are reported in tissues of several species of reef and pelagic fish caught at 14 different atolls in the northern Marshall Islands. Several regularities that are species dependent are evident in the distribution of /sup 239 + 240/Pu among different body tissues. Concentrations in liver always exceeded those in bone and concentrations were lowest in the muscle of all fish analyzed. A progressive discrimination against /sup 239 + 240/Pu was observed at successive trophic levels at all atolls except Bikini and Enewetak, where it was difficult to conclude if any real difference exists between the average concentration factor for /sup 239 + 240/Pu among all fish, which include bottom feeding and grazing herbivores, bottom feeding carnivores, and pelagic carnivores from different atoll locations. The average concentration of /sup 239 + 240/Pu in the muscle of surgeonfish from Bikini and Enewetak was not significantly different from the average concentrations determined in these fish at the other, lesser contaminated atolls. Concentrations among all 3rd, 4th, and 5th trophic level species are highest at Bikini where higher environmental concentrations are found. The reasons for the anomalously low concentrations in herbivores from Bikini and Enewetak are not known.

37227 **In vivo stability and distribution of [^{131}I]iodomethyl trimethylammonium chloride: concise communication.** Huang, C.C.; Friedman, A.M.; Rayudu, G.V.S.; Clark, P.; Fordham, E.W. (Argonne National Lab., IL). *J. Nucl. Med.;* **21**: No. 7, 679-681(Jul 1980).

[^{131}I]iodomethyl trimethylammonium chloride (I-131 TMA) was prepared by the isotope-exchange reaction of diiodomethane with Na^{131}I, followed by reaction with trimethylamine. A specific activity of 20 μCi/mg was obtained. Tissue distributions following intravenous injection of I-131 TMA in mice showed that between 10 min and 2 h, the highest accumulations of radioactivity were in the urine, kidney, and heart. The uptake of this compound in the heart was very rapid, and the levels of radioactivity remained fairly high up to 2 h. At 10, 30, 60, and 120 min the heart-to-blood ratios were, respectively, 10.2, 7.7, 8.3, and 9.6. Thyroid uptake of this compound in the rats and analysis of urine samples of the mouse indicated no extensive deiodination of the compound in vivo. These results show that this compound does have potential for use in myocardial imaging. In addition, its stability in vivo makes it very useful for the radiolabeling of compounds containing quaternary ammonium moieties.

37228 **Comparison of early mortality in baboons and dogs after inhalation of $^{239}PuO_2$.** Bair, W.J. (Battelle Pacific Northwest Lab., Richland, WA); Metivier, H.; Park, J.F.; Masse, R.; Stevens, D.L.; Lafuma, J.;Watson, C.R.; Nolibe, D. Contract EY-76-C-06-1830. *Radiat. Res.;* **82**: No. 3, 588-610(Jun 1980).

Results from experiments with baboons were compared with those from experiments with dogs to determine the relative sensitivity of the two species to early mortality from inhaled $^{239}PuO_2$. To ensure a valid comparison of data developed at two laboratories, methodology differences were minimized by establishing a common

pool of raw data, using the same computer programs to analyze the data, and standardizing assumptions regarding the calculation of plutonium concentration in lungs. Several comparison methods were used involving variations in estimating different parameters used in these calculations. Although nearly all comparisons suggested baboons were slightly more sensitive, none of the methods for comparing the relationship between dose and survival time showed consistently significant differences between baboons and dogs. Although the baboons were physiologically and morphologically immature when exposed to plutonium, whereas the dogs were mature, we concluded that adult baboons and dogs are similarly sensitive to the early effects of inhaled $^{239}PuO_2$. Since only early mortality was considered in this comparison, the results do not apply to possible late effects caused by much lower levels of plutonium than were used in these experiments.

THERMAL EFFECTS

PLANTS

37229 Characteristics of three populations of a swamp annual under different temperature regimes. Christy, E.J.; Sharitz, R.R. (Savannah River Ecology Lab., Aiken, SC). Contract EY-76-C-09-0819. *Ecology;* **61**: No. 3, 454-460(Jun 1980).

This study was undertaken to examine rapid evolution in an herbaceous plant species in response to strong selection associated with increases in temperature. Differences in growth and reproduction in three populations of Ludwigia leptocarpa (Nutt.) Hara, an herbaceous plant dominant along the edges of streams receiving heated nuclear reactor effluent on the United States Department of Energy's Savannah River Plant (SR) in South Carolina, USA, were examined for two growing seasons. Two populations of this semi-aquatic herb were in areas with elevated water temperature, and one population was in an undisturbed swamp. In each of the populations in warmer water, growth and reproductive output were significantly higher than in plants from the undisturbed site. Total percentage germination under controlled temperatures from 22° to 42°C did not differ among the three populations; however, initiation of germination was delayed in all three at 22°. Seedlings from all three populations showed similar growth responses at 22°, whereas at 32° seedlings from the higher temperature locations grew more rapidly. At 42°, survivorship of seedlings from all three seed populations was low. These results indicate selection for temperature-tolerant ecotypes in the disturbed areas.

CHEMICALS METABOLISM AND TOXICITY

37230 Binding of mercurials to membrane suspensions and undenatured proteins. Berg, G.G.; Miles, E.F. (Univ. of Rochester, NY). *Membrane Biochem.;* **2**: No. 1, 117-134(1978).

Binding capacities of membrane suspensions and dissolved compounds for mercurials were titrated by a new potentiometric method. Critical steps included a silver electrode of new design, the use of L-cysteine as a thiol buffer, a nitrogen atmosphere, and pretreatment of samples with equimolar mercurial and cysteine. Titrations had a sharp endpoint, accurate +-26 nmole methylmercury or +-8 nmole mercuric salt. Measurements of binding capacity of bovine serum albumin averaged 93% of the titer predicted for one SH group per molecule; those of human hemoglobin yielded 86 to 91% of the titer predicted for two SH groups per molecule. Yields dropped with exposure of protein solutions or membrane suspensions to atmospheric oxygen. Brain microsomes had significantly higher binding capacities (per milligram of protein) than red blood cell ghosts. The ratio of endpoint titers of CH_3HgCl to $HgCl_2$ averaged 2:1 in assays of cysteine, proteins, and membranes, showing that the assay was free of denaturation artifacts and protein-protein interference. Solutions of EDTA showed measurable binding of Hg^{2+} but not of Ch_3Hg^+. Satisfactory titrations were also obtained with N-ethylmaleimide.

CELLS

37231 Response of CHO cell proliferation and histone phosphorylation to sodium arsenite. Gurley, L.R.; Walters, R.A.; Jett, J.H.; Tobey, R.A. (Los Alamos Scientific Lab., NM). *J. Toxicol. Environ. Health;* **6**: No. 1, 87-105(Jan 1980).

Because of the causal association between arsenic and cancer in humans, studies were initiated to determine whether low levels of arsenic affect cell proliferation and chromatin constituents. Cultured CHO cells were treated with As(III) or As(V) in the form of sodium arsenite ($NaAsO_2$) or sodium arsenate (Na_2HAsO_4), respectively. Arsenite was 10 times more toxic than arsenate. At lower concentrations, 10 μM $NaAsO_2$ induced culture growth kinetics that were radiomimetic. During this division delay, histone HI phosphorylation was reduced to 40% of the control level. It recovered to the control level just before recovery of cell division. Histone H2A phosphorylation was stimulated in the middle of the delay period, followed by stimulation of H3 phosphorylation just before recovery of cell division. ATP pool levels were unaffected at these low arsenite concentrations. The DNA synthesis rate was also reduced during division delay, but it did not recover immediately before resumption of cell division. Flow microfluorometric analysis showed that cell cycle progression was inhibited in G_1, S, and G_2 during the division delay period. On recovery of cell division, cells in S and G_2 regained the capacity to resume cycle traverse earlier than did cells in G_1. Cell survival studies indicated that 89% of the cells survived 24-h treatment with 10 μM $NaAsO_2$.

37232 Selective fluorescence quenching of benzo[a]pyrene and a mutagenic diol epoxide derivative in mouse cells. Wade, C.G. (Univ. of Texas, Austin); Baker, D.E.; Bartholomew, J.C. *Biochemistry;* **17**: No. 20, 4332-4337(1978).

The overlap of the fluorescence spectra of benzo[a]pyrene and its metabolites, including an ultimate carcinogen diol epoxide (+-)-7β,8α-dihydroxy-9α, 10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene, impedes the use of fluorescence in studying the impact of these important carcinogens on cell populations. It is shown that in cells certain collisional quenchers can be used to selectively quench the benzo[a]pyrene fluorescence, leaving the diol epoxide emission. Because such quenchers work only with close contact over distances much less than the cell dimensions, the preferential solubilities can be used to probe fluorophore locations. Benzo[a]pyrene and its diol epoxide derivative were added directly to mouse cells in culture: NMuLi(mouse liver epithelial cells), Balb 3T3 A31 HYF (mouse fibroblast cells), and MSV/MLV Balb 3T3 A31 HYF (Moloney sarcoma virus transformed mouse fibroblast cells). Fluorescence lifetimes of the aromatic hydrocarbons were measured, and fluorescence and flow cytometric studies were made on the effects of various quenchers added to suspensions of these cells. The collisional quencher n-octyl iodide, which is lipid soluble, quenches the benzo[a]pyrene emission by a factor of six with little change in the diol epoxide emission. At comparable molarity, the ionic quencher, KI, is relatively ineffective and does not offer selective effects, presumably because the I^- does not penetrate the cell. At comparable molarity, methylene iodide is a relatively effective quencher for both aromatic hydrocarbons, but it offers little selectivity. The results were, in general, independent of the particular type of mouse cell strain.

MICROORGANISMS

REFER ALSO TO CITATION(S) 37220, 37221

PLANTS

REFER ALSO TO CITATION(S) 37154

INVERTEBRATES

37233 (PNL-SA—8134) Effects of Prudhoe Bay crude oil in sediment on Abarenicola pacifica in laboratory and field experiments. Augenfeld, J.M. (Battelle-Northwest, Sequim, WA (USA). Marine Research Lab.). Feb 1980. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01.

Behavioral responses of organisms are often sensitive indicators of changes in the environment over short time frames. The rate of burrowing of Abarenicola pacifica, a lugworm typical of muddy tidal flats, was studied to determine its response to the presence of hydrocarbons in the environment. If a reduction in burrowing rates is reflected in reduced food intake, a decline in nutritional status might be expected. The level of free amino acids in the tissues was examined as a possible indicator of nutritional status. (ACR)

VERTEBRATES

37234 (DOE/EV/03140—5) Toxicology and metabolism of nickel compounds. Progress report, December 1, 1979-November 30, 1980. Sunderman, F.W. Jr. (Connecticut Univ., Farmington (USA). School of Medicine). 15 Aug 1980. Contract AS02-76EV03140. 15p. NTIS, PC A02/MF A01.

The toxicology and metabolism of nickel compounds [e.g., $NiCl_2$, αNi_3S_2, and $Ni(CO)_4$] were investigated in rats and hamsters.

37235 Effects of exposure to NO or NO_2 and an antigen on the breathing curve pattern in guinea pigs. Yoshida, K.; Kitabatake, M.; Imai, M.; Kasama, K. (Mie Univ. Medical School, Japan). *Environ. Res.;* **21**: No. 2, 458-466(Apr 1980).

The effect of NO and NO_2 of inducing an asthmatic breathing difficulty following inhalation of albumin of different species and the effect on the hypersensitivity toward acetylcholine in the respiratory tract were investigated to study the relation between asthma and NO, NO_2. Two experimental groups, the group exposed to NO (average 5.02 ppM) and the group exposed to NO_2 (average 5.00

ppM), were prepared. The exposures to NO or NO_2 gas (30 min) and, after 20 min, the albumin solution spray were repeated ten times, twice a week. For these exposures, breathing curves were continuously autorecorded with a body plethysmograph to ascertain the intensity of the asthmatic respiratory difficulty. Comparison showed that animals with stronger patterns of asthmatic dyspnea were greater in number when exposed to NO or NO_2 and albumin (NO or NO_2 group) than when exposed only to albumin (control group). Following all exposures, each group was exposed to an acetylcholine spray of the same concentration. In the case of the NO, NO_2 groups, an increase in the susceptibility of the airway tract to acetylcholine could be observed.

37236 Differential accessibility of (+-) trans-7β,8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene to histone proteins. Koostra, A.; Slaga, T.J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **108**: No. 2, 321-325(Dec 1979).

The data presented here would, therefore, suggest that the differential affinity of B[a]P diol epoxide (anti) for chicken erythrocyte chromosomal histone proteins in vitro appears to be a function of the three-dimensional arrangement of the nucleosomal subunit structure, and that the presence of the very lysine-rich histones prevents the carcinogen from interacting with histone H2A. These histone modifications may well play an important part in changing the conformational and functional relationship of chromatin, and by doing so, initate the carcinogenic events. Therefore, these protein modifications could be related to the epigenetic changes that have been postulated to occur [23], in the process of carcinogenesis.

37237 Distribution and retention of inhaled selenious acid and selenium metal aerosols in beagle dogs. Weissman, S.H.; Cuddihy, R.G.; Burkstaller, M.A. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). pp 477-482 of Trace substances in environmental health. XIII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1979).

From 13. annual conference on trace substances in environmental health; Columbia, MO, USA (4 Jun 1979).

Distribution and retention of inhaled selenious acid and selenium metal aerosols representative of those produced in fossil fuel combustion were studied. Beagle dogs were given 20-60 μg Se/kg body wt by inhalation or by instillation into the upper respiratory tract or stomach. Virtually all of the inhaled selenious acid aerosol was rapidly absorbed into the blood from the lung, gastrointestinal tract and directly through the nasal membranes. The long-term component of the whole body retention function for inhaled H_2SeO_3 had a half-life of about 30 days and accounted for about 20% of the initial Se deposited. Selenium that was absorbed into the systemic circulation was translocated to the liver, kidney, pelt and blood. Long-term retention was primarily in liver, pelt and blood. Internal organ distribution for inhaled Se metal aerosol was similar to that observed for H_2SeO_3 aerosols except more Se was retained in the lungs of these animals.

MAN

REFER ALSO TO CITATION(S) 36008, 37225

37238 Trace substances in environmental health. XIII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1979). 521p. (CONF-790673—). Environmental Trace Substances Research Center, Route 3, Columbia, MO 65201.

From 13. annual conference on trace substances in environmental health; Columbia, MO, USA (4 Jun 1979).

Separate abstracts were prepared for 35 of the 56 papers presented in these proceedings. Two of the remaining 21 papers have appeared previously in the data base. The other 19 papers are not within our scope of interest. (ERB)

37239 Pulmonary retention of lead: an experimental study in man. Morrow, P.E.; Beiter, H.; Amato, F.; Gibb, F.R. (Univ. of Rochester, NY). *Environ. Res.;* **21**: No. 2, 373-384(Apr 1980).

This human investigation of lead absorption from the lungs utilized two forms of lead, lead chloride and lead hydroxide; the former was used in picogram amounts and the latter at microgram levels. These two species of lead were selected in an attempt to simulate the range of physicochemical properties found in atmospheric lead (urban air). Aerosols labeled with lead-203 were made of comparable aerodynamic size (MMAD 0.25 μm +- 0.1) by using sodium chloride as the deposition-determining aerosol. After brief, mouthpiece exposures, 17 subjects were followed by serial counting with a thoracic array of 12 2-in. scintillation detectors and two 2-in. leg counters, all coupled to single channel analyzers. Serial blood samples were also taken. The two exposure groups showed similar total deposition values (23 vs 26%) and the same biological retention halftimes, viz., 22.6 h. When the retention data were corrected for blood-borne ^{203}Pb, the biological halftimes for lung lead retention averaged 13.1 and 14.2 h, respectively, and were not significantly different. Blood build-up data were also indistinguishable in the two groups. The authors discuss these findings in relation to other inhalation studies and conclude the collective evidence supports the view that atmospheric lead is rapidly and completely absorbed from the human lungs.

37240 Age dependent biological half-time of cadmium in the human renal cortex. Haddock, A.G.; Travis, C.C. (Oak Ridge National Lab., TN). pp 190-194 of Trace substances in environmental health. XIII. Hemphill, D.D. (ed.). Columbia, MO; University of Missouri (1979).

From 13. annual conference on trace substances in environmental health; Columbia, MO, USA (4 Jun 1979).

The purpose of this paper is to present evidence which suggests that the biological half-time of cadmium in the human renal cortex is age dependent and to determine the nature of this dependency. To aid in understanding the retention of Cd by the human body, a one compartment model of the human renal cortex was developed. The model assumed an age-dependent caloric intake by individuals and a recent increase in environmental levels of Cd. The effect of smoking was incorporated into the model but, because of their small contributions, Cd intakes from drinking water and normal air were not included. Using the model, a theoretical study was performed to determine Cd concentration in the renal cortex as a function of age. It was found that the cohort effect caused by the recent rise in environmental levels of Cd did not account for the magnitude of the decline in renal Cd levels with increasing age observed in autopsy studies. Functional and morphological changes in the renal cortex of older age groups were postulated by the authors as the major cause of this decline. When the model was modified to reflect these changes, a good match was obtained between theoretical results and autopsy studies. Using the modified model as a basis, the age-dependent biological half-time of Cd in the human renal cortex was determined. It was found to decrease from 35 years at birth to 11 years at age 80.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 36248

37241 (AD-A—079799/3) **Laser hazards bibliography - October 1979.** Sliney, D.H.; Krial, N.; Griffis, D.W.; Ryan, L.L. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA)). Oct 1979. 169p. NTIS, PC A08/MF A01.

The Laser Hazards Bibliography consists of 2,088 references in the open literature broken into subject categories which relate to general biological effects, the eye, the skin, laser safety, laser propagation in the atmosphere, and laser measurements.

37242 (AD-A—079830/6) **Low-power laser alteration of physiological processes. Final report Oct 78-Apr 79.** Reed, R.D. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Nov 1979. 41p. NTIS, PC A03/MF A01.

The report summarizes a recent analysis of research concerning the alteration or stimulation of biological processes by low-power laser irradiation. A survey of reported studies is given, along with abstracted biomedical case reports. The analysis compares reported laser exposure levels to current safety standards, solar irradiance levels, and exposure levels from published reports of low-level laser effects on visual function. An estimated depth of penetration for the commonly used helium-neon laser is calculated. Thermal modeling was used, with reported laser exposure levels, to estimate the possible contribution of hyperthermia to reported bioeffects. Possible mechanisms are discussed for the coupling of laser energy to cellular processes. Results are correlated to current Air Force research on laser bioeffects.

37243 (CONF-800491—, pp 379-382) **Study of the biological and ecological effects of SPS microwave power on the honey bee.** Gary, N.E.; Westerdahl, B.B. (Univ. of California, Davis). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The proposed SPS system will increase ambient microwave energy levels in receiving antennae and in adjacent areas. Possible biological and environmental effects (whether adverse or beneficial) from microwave radiation within the surrounding rectennae need to be defined for a broad spectrum of animal and plant life. This information is needed in order to minimize possible hazards and to permit maximum possible use of microwave illuminated areas. Research needs are particularly critical for airborne biota such as invertebrates and birds which cannot be excluded from the rectennal area. The following experiments have been completed in recent months: (1) the orientaion, navigation and memory of foraging bees; (2) the survival and longevity of adult worker bees and (3) the survival of honey bee brood (eggs, larvae and pupae) were studied

following 30 minute exposures to 5 levels (3, 6, 9, 25, and 50 mw/cm²) of 2.45 GHz CW radiation. Results are summarized. (WHK)

37244 (CONF-800491—, pp 383-386) **SPS microwave effects on airborne biota status report.** Battista, S.P.; Cook, E.J.; Kunz, T.H.; Hoyt, D.; Wasserman, F.A.; Byman, D.; Youngstrom, K. (Arthur D. Little, Inc., Cambridge, MA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A building has been completely renovated and provided with all the services required for maintaining and exposing birds to a wide range of microwave power densities (2.45 GHz). This dedicated microwave exposure facility was constructed at an isolated location to minimize the possibility of accidental exposure of the public to high voltage and microwave radiation. The exposure facility and experiments to be performed are briefly described. (WHK)

37245 (CONF-800491—, pp 387-391) **Review of effects of SPS-related microwaves on reproduction and teratology.** Berman, E. (Health Effects Research Lab., Research Triangle Park, NC). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Some of the problems to be encountered in an evaluation of SPS-related microwaves as an influence on human health are discussed. The areas of reproductive function discussed are teratology, where the fetus is treated while in the dam and the fetus is then examined for alterations and male reproductive functions, such as sperm production. (WHK)

37246 (CONF-800491—, pp 392-395) **Biological effects of chronic pre- and post-natal exposure of squirrel monkeys to SPS frequency microwaves.** Kaplan, J.N. (SRI International, Menlo Park, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The purpose of this study was to determine whether low-level microwave irradiation, at or below the ANSI-recommended radiation protection guide for human exposure, over an extended time had any effect on the pre- and postnatal development of the squirrel monkey. Procedures and results are reported. (WHK)

37247 (CONF-800491—, pp 552-554) **Study of Federal microwave standards.** David, L. (PRC Energy Analysis Co., McLean, VA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A study has been made to identify the present and future federal regulatory processes which may impact the permissible levels of microwave radiation emitted by the SPS Microwave Power Transmission System (MPTS). The historical development and promulgation of US occupational and public microwave standards is traced, evolving from reported bioeffects among military personnel operating radar equipment during World War II. Included is an overview of the philosophical variances between Eastern and Western countries which have resulted in world-wide permissible exposures to microwaves that differ by four orders of magnitude. For the United States, and a majority of Western countries, the concept of risk/benefit criterion has been accepted, involving use of an adequate safety margin below a known threshold of hazard. Soviet and most East European microwave standards on the other hand, are based on a no-effect philosophy - all deviations from normal are hazardous. Yet to be determined, however, are definitions of what connotes a hazard or adequate safety margin in terms of microwave exposure.

37248 (DOE/ER—0069) **Environmental assessment for the Satellite Power System (SPS) Concept Development and Evaluation Program (CDEP).** Valentino, A.R. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 128p. NTIS, PC A07/MF A01.

In the satellite power system (SPS), satellites in geosynchronous earth orbit would collect solar energy in space, convert it to microwaves, and transmit the microwaves to receiving antennas (rectennas) on earth. At the rectennas, the microwave energy would be converted to electricity. This SPS environmental assessment considers the microwave and nonmicrowave effects on the terrestrial environment and human health, atmospheric effects, and effects on electromagnetic systems. No environmental problem has been identified that would preclude the continued study of SPS technology. To increase the certainty of the assessment, some research has been initiated and long-term research is being planned.

37249 (DOE/ER/10041—02) **Study of federal microwave standards.** David, L. (PRC Energy Analysis Co., McLean, VA (USA)). Aug 1980. Contract AC01-79ER10041. 84p. NTIS, PC A05/MF A01.

Present and future federal regulatory processes which may impact the permissible levels of microwave radiation emitted by the SPS Microwave Power Transmission (MPTS) were studied. An historical development of US occupational and public microwave standards includes an overview of Western and East European philosophies of environmental protection and neurophysiology which have led to the current widely differing maximum permissible exposure limits to microwaves. The possible convergence of microwave standards is characterized by a lowering of Western exposure levels while Eastern countries consider standard relaxation. A trend toward stricter controls on activities perceived as harmful to public health is under way as is interest in improving the federal regulatory process. Particularly relevant to SPS is the initiation of long-term, low-level microwave exposure programs. Coupled with new developments in instrumentation and dosimetry, the results from chronic exposure program and population exposure studies could be expected within the next five to ten years. Also discussed is the increasing public concern that rf energy is yet another hazardous environmental agent.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 36165, 37178, 37241, 37242

37250 (DOE/EV/06020—T4) **Fire safety of LPG in marine transportation.** Martinsen, W.E.; Johnson, D.W.; Welker, J.R. (Applied Technology Corp., Norman, OK (USA)). Aug 1980. Contract AC05-78EV06020. 216p. NTIS, PC A10/MF A01.

This report contains an analytical examination of cargo spill and fire hazard potential associated with the marine handling of liquefied petroleum gas (LPG) as cargo. Principal emphasis was on cargo transfer operations for ships unloading at receiving terminals, and barges loading or unloading at a terminal. Major safety systems, including emergency shutdown systems, hazard detection systems, and fire extinguishment and control systems were included in the analysis. Spill probabilities were obtained from fault tree analyses utilizing composite LPG tank ship and barge designs. Failure rates for hardware in the analyses were generally taken from historical data on similar generic classes of hardware, there being very little historical data on the specific items involved. Potential consequences of cargo spills of various sizes are discussed and compared to actual LPG vapor cloud incidents. The usefulness of hazard mitigation systems (particularly dry chemical fire extinguishers and water spray systems) in controlling the hazards posed by LPG spills and spill fires is also discussed. The analysis estimates the probability of fatality for a terminal operator is about 10^{-6} to 10^{-5} per cargo transfer operation. The probability of fatality for the general public is substantially less.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 36115, 37181

37251 **Geohydrologic investigations of buried metamorphic rock and mudstone for the storage of radioactive waste.** Marine, I.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). pp 49-56 of Low flow, low-permeability measurements in largely impermeable rocks. Paris, France; OECD (1979).

From Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks; Paris, France (19 Mar 1979).

From 1961 to 1972 a geohydrologic investigation of crystalline metamorphic rock and Triassic mudstone was carried on at the Savannah River Plant near Aiken, south Carolina, U.S.A., operated by the U. S. Department of Energy, for the purpose of evaluating the feasibility of storing radioactive waste in these host rocks. Although this investigation is no longer active, many of the concepts, testing methods, and results developed in this investigation are applicable to investigations currently being conducted at other locations fo geologic storage of radioactive waste.

37252 (RHO-BWI-C—73) **Compilation of a reconnaissance surface geologic map of Oregon underlain by Columbia River basalt.** Farooqui, S.M. (Shannon and Wilson, Inc., Portland, OR (USA)). Mar 1980. Contract AC06-77RL01030. 160p. NTIS, PC A08/MF A01.

A preliminary reconnaissance surficial geologic map of the late Cenozoic sediments and volcanic rocks overlying the Columbia River Basalt Group in the Dalles, Pendleton, Grangeville, Baker, Canyon City, and Bend, Oregon quadrangles was compiled. The

compilations are based on previous work. No field checks were made. (ACR)

37253 (SAND—79-0276) **Basic data report for drillhole WIPP 19 (Waste Isolation Pilot Plant-WIPP).** (Sandia National Labs., Albuquerque, NM (USA); Geological Survey, Denver, CO (USA)). Mar 1980. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01.

WIPP 19 is an exploratory borehole whose objective was to determine the nature of the near-surface formations after seismic information indicated a possible fault. The borehole is located in section 20, T.22S., R.31E., in eastern Eddy County, New Mexico, and was drilled between April 6 and May 4, 1978. The hole was drilled to a depth of 1038.2 feet and encountered, from top to bottom, surficial Holocene deposits (7', including artificial fill for drill pad), the Mescalero caliche (7'), the Santa Rosa Sandstone (82'), the Dewey Lake Red Beds (494'), the Rustler Formation (315'), and the upper portion of the Salado Formation (143'). Cuttings were collected at 10-foot intervals. A suite of geophysical logs was run to measure acoustic velocities, density, and radioactivity. On the basis of comparison with other geologic sections drilled in the area, the WIPP 19 section is a normal stratigraphic sequence and it does not show structural disruption. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes. The WIPP will also provide facilities to research interactions between high-level waste and salt.

37254 **Permeability of generic repository rocks at simulated in situ conditions.** Heard, H.C.; Trimmer, D.; Duba, A.; Bonner, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). pp 69-83 of Low flow, low-permeability measurements in largely impermeable rocks. Paris, France; OECD (1979).

From Workshop on Low-Flow Low permeability measurements in Langley Impermeable rocks; Paris, France (19 Mar 1979).

New laboratory data are reported on the effect of confining (lithostatic) pressure, pore-water pressure, and principal stress difference on permeability of Westerly granite and White Lake gneissic granite. Permeabilities as low as 10^{-19} cm^2 (10^{-11} D) have been measured successfully, using a transient technique. Principal strains, electrical conductivity, and compressional velocity are determined simultaneously. Applied loads on the 15-cm diameter by 28-cm long test sample are controlled automatically and all data are taken by a micro-computer. Results on the gneissic indicate permeabilities of 10^{-18} to 10^{-19} cm^2 that appear to be unaffected either by effective pressure or by stress. The granite yields permeabilities of 4.10^{-16} cm^2 that decrease by a factor of two with pressure and vary by a factor of two with stress. When compared to the initial value, compressional velocities increase by 4% and conductivity decreases by 50% as pressure is increased to 50 MPa in the gneissic granite. In granite, these become 3% and 58%, respectively. At pressure, loading of the granite to 0.5 of failure stress increases conductivity by about 20%.

GEOPHYSICS

REFER ALSO TO CITATION(S) 36148

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 35998

37255 **Seismic exploration technique .** Lindseth, R. US Patent 4,210,968. 1 Jul 1980. Filed date 16 Dec 1975. vpp.

A method of producing a display of the acoustic velocity characteristics of individual strata in a geologic section comprising the steps of: propagating acoustic energy through said section from a surface transmission station; detecting at least one receiving station at the surface of the earth acoustic energy reflected from interfaces within the section; recording signals representative of the amplitude of the received energy as a function of time; compensating the signals representative of energy reflected from each interface for the transmission losses due to transmission through the strata above that interface; filtering the compensated signals to remove signals having frequencies below a preselected frequency threshold; inverting the reflection coefficients to determine a series of velocity coefficients; providing signals below the preselected threshold representative of a gross velocity profile of the section; adding the compensated filtered velocity coefficient signals to the signals representative of gross velocity profile; and displaying the resulting added signals.

GEOPHYSICAL SURVEY METHODS

37256 (UCRL—52961) **Geotomography applied at the Stripa Mine in Sweden.** Okada, J.T.; Laine, E.F.; Lytle, R.J.; Daily,W.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 7 Apr 1980. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

LLNL made ultrahigh-frequency (450-MHz) electromagnetic borehole-to-borehole transmissions in the Stripa Mine near Guldsmedshyttan, Sweden, in April 1979. Transmission loss measurements were made between four sets of 76-mm boreholes 30 m long, located at the end of a drift. Distances between the boreholes varied from 2 to 22 m. More than 25,000 data points were taken. A geotomograph was constructed to show the variation of attenuation between boreholes. The observed spatial variation of electromagnetic attenuation may be related to the expected stress relief created by the mine. Transmission loss measurements were also made between two converging boreholes drilled from the surface to points near the mine. Data taken at 21 MHz show a nearly uniform attenuation within this sampled region. These experiments demonstrate that geotomographic data collection/interpretation provides high-resolution images of the underground environment and can provide useful input to those charged with providing the detailed site characterizations needed for both short- and long-term monitoring of underground nuclear waste repositories.

37257 **Rotating telluric field measurements.** Groenendyke, G.; Hoehn, G. (to Mobil Corp). US Patent 4,210,869. 1 Jul 1980. Filed date 2 Apr 1979. vpp.

In magneto-telluric geophysical exploration, the system is described for determining the earth's electric telluric field in two orthogonal directions comprising: (A) means for measuring the earth's telluric field along a firstfhorizontal line in a first known direction and for producing a first telluric signal representative thereof, (B) means for measuring the earth's telluric field along a second horizontal line in a second known direction and producing a second telluric signal representative thereof, (C) means for producing a pair of signals representative of the values of said first and second telluric signals along a third predetermined horizontal line and for combining said pair of signals to provide a signal representative of the earth's electric telluric field along said third horizontal line, and (D) means for producing a pair of signals representative of the values of said first and second telluric signals along a fourth horizontal line orthogonal to said third horizontal line and for combining said pair of signals to provide a signal representative of the earth's electric telluric field along said fourth horizontal line.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 35952, 35992, 36112, 36114, 36116, 36117, 36127, 36131, 36133, 36147, 36508, 37127, 37366

37258 (LBL—8648, pp 229-231) **Nature and distribution of secondary minerals in the basalts of the Pasco Basin, Washington, and their relation to the disposal of nuclear wastes.** Benson, L.V.; Carnahan, C.L.; Apps, J.A.; Corrigan, D.J.; Frisch, C.J.; Mouton, C.A.; Teague, L.K. 1978.

In Earth Sciences Division. Annual Report 1978.

37259 (LBL—8648, pp 232-241) **Hanford near-surface test facility heater experiments.** DuBois, A. 1978.

In Earth Sciences Division. Annual Report 1978.

37260 (ONWI—88, pp 156-159) **Hydrogeological exploration program of Gerleben.** Vierhuff, H. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The first drillings in the area near the diapir demonstrated a complicated system of unconsolidated aquifers and aquicludes of Quaternary and Tertiary age. The diapir obviously did not completely stop moving upwards during the Tertiary. Glacial erosion during the Early Quaternary glaciation in the Gorleben area did not reach the caprock, but ceased very near to it, leaving a thin sheet of clay layers between aquifers and the caprock. There is no evidence for any dislocations which may have happened since the beginning of the last glaciation. Geophysical logging in open holes and chemical analysis of water samples show a great variety of groundwater quality at different depths.

37261 (ONWI—88, pp 352-356) **Summary of lab studies of salt properties.** Staupendahl, G. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Data are presented on the dynamic elastic constants and strengths of different Asse salt rocks, and on the uniaxial conpressive strength and axial deformation at failure of the younger halite crystals. 2 figures, 2 tables. (DLC)

37262 (ONWI—88, pp 357-366) **Summary of BGR lab studies of salt properties.** Hunsche, U. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

In the Federal Institute for Geosciences and Natural Resources (BGR) laboratory studies of the mechanical properties of natural salt have been carried out for several years, with the aim to find the constitutive laws of rock salt. Referring to nuclear waste disposal there exists a special interest in the influence of temperature and long times. Results which are shown in this paper are subdivided in the evaluation of creep properties and the measurement of the stress state at failure.

37263 (ONWI—88, pp 392-396) **Investigation on the migration and release of water within rock-salt.** Jockwer, N. (Institut fuer Tieflagerung, Zellerfeld, Germany). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The water content of a large number of samples of Older and Younger Halit exists in four different forms: hydration water, crystal boundary surface water, brine droplets within negative crystals (inclusions), and water molecules trapped within the crystal lattice. A thermogravimetric investigation was conducted to show what happens to the water as the temperature is increased. Preliminary results are reported. (DLC)

37264 (ONWI—88, pp 397-403) **Recent WIPP brine migration experiments.** Hunter, T.O. (Sandia Labs., Albuquerque, NM). 1979.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

Sandia laboratories has initiated some experiments to assess the mechanisms which influence the migration of fluids in rock salt. Two series of laboratory studies have been concluded recently, and plans for an initial in-situ experiment have been formulated. In addition, theoretical modeling studies are underway to provide formulations for predictions for both experiments and actual waste emplacements.

37265 **Analysis of borehole geophysical data in an evaporite sequence at Salt Valley, Utah.** Daniels, J.J.; Scott, J.H.; Hite, R.J. (Geological Survey, Denver, CO). pp 19p, Paper M of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

Interpretation of the lithology of an interbed sequence (thin-bedded sediments between thick layers of salt) is often difficult due to the presence of dolomitic sandstones and halite inclusions. The most useful well logging measurements in an evaporite sequence are gamma-ray, neutron-neutron, density, and acoustic velocity. The high resistivity of salt and the low resistivity of commonly used drilling fluids (brine muds) make it difficult to obtain measurements of electrical properties in an evaporite sequence. Tests of a single-coil induction probe at Salt Valley show good resolution of the interbed lithologies and may be useful in determining moisture in the halite. Complex structural features (faulting and folding) are difficult to interpret with individual well logs. Interpretation of complex folding can be aided by plotting the percent frequency of occurrence of well log response values for the interbeds. Limbs of a fold that intersect the drill hole at different dip angles yield similar distribution patterns on these percent-frequency plots.

37266 **Geologic appreciation of shaly sands.** Almon, W.R. (Cities Service Co., Tulsa, OK). pp 14p, Paper WW of Transactions of the SPWLA twentieth annual logging symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1979).

From 20. annual logging symposium; Tulsa, OK, USA (3 Jun 1979).

The shale in most sandstones is a product of diagenesis rather than deposition. As a result it tends to be of different mineralogy from the associated detrital shales and to occur almost exclusively within the pore system of the sandstone. The precipitation of diagenetic minerals within the pore space of a sandstone greatly increases the specific surface area of the pore system. The conductane associated with the clay mineral surface can cause significant reductions in the true resistivity of the formation. This leads to serious problems in log interpretation whose true cause has only recently been recognized by the Waxman-Smits model and the dual water model of rock conductivity. The development of very high specific surface areas in diagenetically altered sandstones is recognized by these newer analytical models. If the techniques can be sufficiently refined so that the surface area can be determined from log measurements, then a theoretical relationship between the surface area and permeability might provide the basis for a reliable permeability log.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 36017

PHYSICS RESEARCH

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

STARS

37267 **Computer simulations of close encounters between single stars and hard binaries.** Hills, J.G.; Fullerton, L.W. (Department of Astronomy and Astrophysics, Michigan State University, East Lansing, Michigan 48824). *Astron. J.*; **85**: No. 9, 1281-1291(Sep 1980).

We have simulated 5175 close encounters between hard binaries and single stars having masses M_3 ranging from 0.01 to 100 times the mass M_1 of the binary components. For all mass ratios the encounters lead to a net average fractional increase $<\Delta E/E_0>$ in the binding energy of the binary. For $M_3/M_1 <$ or $\simeq 3$, we find that $<\Delta E/E_0> \simeq 0.7(M_3/M_1)$. For $M_3/M_1 >$ or $\simeq 3$, $<\Delta E/E_0> \simeq 3.1$. The average recoil velocity of the single star after a close encounter increases from 0.84 of the initial orbital velocity of the binary for $M_3 << M_1$ to 1.8 times the orbital velocity for $M_3 >> M_1$. About two-thirds of the total recoil energy released in encounters at all impact parameters is produced by encounters in which the recoil velocity is less than the average recoil velocity at zero impact parameter. The probability that the impacting star will be a member of the post-encounter binary after a close encounter is virtually nonexistent if $M_3/M_1 < 0.2$ and unity if $M_3/M_1 > 1.6$. Except for a resonance-like peak in the transition zone between $M_3/M_1 = 0.2$ and 1.6, the average post-encounter eccentricity increases monotonically with increasing values of M_3/M_1. We use the results of the computer simulations to compute improved cross sections governing the rate at which binaries feed kinetic energy into their parent star clusters. We compare these to earlier work.

37268 **Possible optical observation of the companion star to the binary pulsar PSR 1913+16.** Crane, P. (European Southern Observatory, Geneva (Switzerland)); Nelson, J.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Tyson, J.A. (Bell Labs., Murray Hill, NJ (USA)). *Nature (London)*; **280**: No. 5721, 367-370(2 Aug 1979).

Deep R band CCD photographs of the region surrounding the binary pulsar PSR1913 + 16 have been obtained with the 4-m telescope of the Kitt Peak National Observatory. Using an accurate astrometric solution, a star with Msub(R) = 20.9 has been found at the precise coordinates of the pulsar. Possible interpretations of this result, including the unlikely (< 3%) possibility that it is an accidental superposition of a field star, are discussed. If this object is the physical companion to the pulsar, it is probably a helium star.

SOLAR PHENOMENA

37269 (LA-UR—80-2732) **Numerical simulation of the solar granulation.** Cloutman, L.D. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—2). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

The solar granulation has been simulated by numerical solution of the multidimensional, time-dependent, nonlinear Navier-Stokes equations applied to the solar atmosphere. Granules may be explained as buoyantly rising bubbles created at the level where T = 8000 K, and which have collapsed into vortex rings. The calculation is in quantitative agreement with observations and has a number of implications for solar physics and convection theory.

PLANETARY PHENOMENA

37270 **Radio observation of Comet Meier (1978f) in 18-cm OH lines.** Giguere, P.T.; Huebner, W.F.; Bania, T.M. (Theoretical Division, T-4, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG:36. *Astron. J.*; **85**: No. 9, 1276-1280(Sep 1980).

Observations of 18-cm OH spectral lines in comet Meier (1978f) with the 1000-ft. Arecibo telescope show spatial resolution of the OH coma by the 2'.9 beam ($=3.7 \times 10^5$ km). The data agree with predictions of the solar Fraunhofer spectrum-pumping theory of comet OH excitation. On the assumption that the OH parent molecule (e.g., H_2O) has a Haser-model scale length $\simeq 1.0 \times 10^5$ km at heliocentric distance 1 AU, we derive an OH scale length $< 10^6$ km,

and probably near 1.0 x 10^5 km. Assuming a recently calculated value of the OH lifetime and the solar radiative pumping model, our results indicate an OH production rate $\sim 10^{29}$ s^{-1} at heliocentric distance 2 AU.

37271 Model of comet comae. II. Effects of solar photodissociative ionization. Huebner, W.F.; Giguere, P.T. (Theoretical Division, T-4, Los Alamos Scientific Laboratory). *Astrophys. J.;* **238**: No. 2, 753-762(1 Jun 1980).

Improvements to our computer model of coma plotochemistry are described. These include an expansion of the chemical reactions network and new rate constants that have been measured only recently. Photolytic reactions of additional molecules are incorporated, and photolytic branching ratios are treated in far greater detail than in our previous work. A total of 25 photodissociative ionization (PDI) reactions are now considered (as compared to only 3 PDI reactions previously). Solar PDI of the mother molecule CO_2 is shown to compete effectively with photoionization of CO in the production of observed CO^+. The CO^+ density peak predicted by our improved model, for COP_2 or CO mother molecules, is deep in the inner coma, in better agreement with observation than our old CO_2 model. However, neither CO_2 nor CO mother molecule calculations reproduce the CO^+/H_2O^+ ratio observed in comet Kohoutek. PDI products of CO_2, CO, CH_4, and NH_3 mother molecules fuel a complex chemistry scheme, producing inner coma abundances of CN, C_2, and C_3 much greater than previously calculated.

ATMOSPHERIC PHYSICS

37272 (DOE/ET/03425—19) **Balance of the tropospheric ozone and its relation to stratospheric intrusions indicated by cosmogenic radionuclides. Technical progress report, November 1, 1979-June 30, 1980.** Reiter, R.; Kanter, H.J.; Sladkovic, R.; Jaeger, H.; Munzert, K.H. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Garmisch-Partenkirchen (Germany, F.R.). Inst. fuer Atmosphaerische Umweltforschung). Jul 1980. Contract AC02-76EV03425. 52p. NTIS, PC A04/MF A01.

The balance of the tropospheric ozone is investigated considering the ozone sources with emphasis on tropospheric pollutants and stratospheric-tropospheric exchange processes. The measuring series of ozone concentration from the years 1977 to 1979 obtained at three different levels of the boundary layer (700, 1800, and 3000 m a.s.l.) have been analyzed. In the course of this work the data have been evaluated in correlation with relevant meteorological parameters, for instance solar radiation. It became evident that for the different levels various types of ozone sources must be assumed. At the mountain stations prevails influx of stratospheric ozone. In the valley, however, photochemical production must be regarded as main source. Experiences with a New Zealand filter photospectrometer are discussed. A systematic study of ozone profiles obtained by balloon sondes revealed that as a rule after solar flares associated with Forbush effect drastic changes of the ozone profile take place in the lower stratosphere. Then, extremely high maxima of the ozone partial pressure are observed immediately above the tropopause and also intensive influxes of tropospheric air into the stratosphere between 200 and 100 mb. At mountain stations just above the timberline the amplitude of the CO_2 daily variation due to vegetation is now balanced to such an extent that these measurements can be regarded as representative of the free atmosphere and thus seem to be sited for trend analyses. Effects of a modified lidar system on measurements of stratospheric aerosol layers and necessary corrections in evaluating the backscatter profiles are disucussed and most recent measuring results presented.

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 36249, 36250, 36251, 36252, 36253, 36267

37273 (CONF-800491—, pp 483-484) **Lagopedo experiments.** Pongratz, M.B.; Smith, G.M.; Horak, H.G.; Simons, D.J.; Sutherland, C.D.; Wolcott, J.H.; Zinn, J. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Lagopedo ionospheric depletion experiments conducted with sounding rockets launched from the DOE launch facility in Kauai, Hawaii, represent unique experimental benchmarks for testing the predictions of theoretical codes designed to calculate the ionospheric effects of heavy lift launch vehicles' exhaust gases. The reactive gases were generated by detonating an explosive which was carried to F-region altitudes as the daughter component of a mother-daughter rocket payload configuration. The mother component of the payload carried in situ and total electron content diagnostic packages. To date, the Lagopedo experiments have provided the only existent in situ diagnostics of an artificial ionospheric depletion. Ground-based observations included imaging optics and photometry, ionosonde and total electron content diagnostics, and radar measurements. Some results are briefly described. (WHK)

37274 (CONF-800491—, pp 485-486) **Ice formation during Lagopedo UNO.** Lebeda, C.F. (EG & G, Los Alamos, NM); Pongratz, M.B. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Hydrocarbon combustion products such as CO_2 and H_2O, as emitted from rocket engines, are known to deplete the electron and ion content of the ionosphere. Operation Lagopedo was executed to determine the behavior of these reactive species in the ionosphere under controlled conditions. Operation Lagopedo consisted of two rocket-borne injections of CO_2 and H_2O into the F-2 region of the ionosphere near Hawaii during September of 1977. The first of these injections occurred in sunlight, the second did not. Photographic images of the first injection yield unique experimental information concerning the effectiveness of H_2O in depleting the ionosphere. The expanding water vapor froze and was not able to react with the local electrons and ions as ice. Subsequent sublimation of the ice particles to vapor made the H_2O capable of reacting with the ambient electrons and ions. Determination of the amount of the water that froze and the duration that it remained frozen defines temporally how much of the water can react. The results of the analysis of the images of the scattered sunlight used to determine the amount of water that froze and the decay time for the ice are given.

37275 (CONF-800491—, pp 487-488) **Theoretical investigations of ionospheric modifications produced by rocket exhaust.** Bernhardt, P.A. (Stanford Univ., CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Placing a Solar Power Satellite in orbit will probably require the firing of rocket engines in the ionospheric F-layer. These engine burns will cause a temporary reduction in the ionospheric plasma concentration. The plasma reduction process involves chemical reactions between the exhaust and the monoatomic ions in the atmosphere above 100 km altitude. Polyatomic neutral species, such as H_2O, CO_2, H_2 and N_2, are common constituents of rocket exhaust. By reaction with the O^+ ion in the F-layer, these neutrals are converted into polyatomic ions such as H_2O^+, O_2^+, OH^+ and NO^+. These ions rapidly recombine with the free electrons in the ionosphere. The net effect of the chemical reaction is to convert as much as 95% of the local plasma into neutral species. The rates for reaction between the O^+ ion and the exhaust molecules can be 1000 times larger than the rates for reaction with the normal constituents of the atmosphere. Modeling the ionospheric modification process is briefly discussed.

37276 (CONF-800491—, pp 489-492) **Effects of rocket exhaust products in the thermosphere, and ionosphere.** Zinn, J. (Los Alamos Scientific Lab., NM); Sutherland, D.; Stone, S.N.; Duncan, L.M.; Behnke, R. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The current state of understanding of the problem of ionospheric F-layer depletions produced by chemical effects of the exhaust gases from large rockets is reviewed with particular emphasis on the Heavy Lift Launch Vehicles (HLLV) proposed for use in the construction of solar power satellites. The currently planned HLLV flight profile calls for main second-stage propulsion at apogee. The second-stage engines deposit 9 x 10^{31} H_2 molecules between 74 and 124 km. Model computations show that they diffuse gradually into the ionospheric F region (i.e., above 200-km altitude), where they lead to weak but widespread and persistent depletions of ionization and continuous production of H atoms. The orbit-circularization burn deposits 9 x 10^{29} exhaust molecules at about 480-km altitude. These react rapidly with the F2 region 0^+ ions, leading to a substantial (factor of three) reduction in plasma density, which extends over a 1000- by 2000-km region and persists for four to five hours.

MAGNETOSPHERIC PHENOMENA

37277 Electrostatic flow shear instability. Gary, S.P.; Schwartz, S.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **85**: No. A6, 2978-2980(1 Jun 1980).

This paper considers a plasma microinstability driven by a macroscopic shear in the flow velocity parallel to a uniform magnetic field. The linear electrostatic dispersion relation for a Vlasov plasma is used. The flow shear instability which results has zero frequency. The wave number at maximum growth rate is of the order of the reciprocal ion gyroradius, but there is appreciable growth at the reciprocal of the electron gyroradius. This instability may provide wave-particle viscous effects at the magnetopause or stream-stream interfaces in the solar wind.

37278 Deceleration of the solar wind upstream from the earth's bow shock and the origin of diffuse upstream ions. Bame, S.J.;

Asbridge, J.R.; Feldman, W.C.; Gosling, J.T.; Paschmann, G.; Sckopke, N. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **85**: No. A6, 2981-2990(1 Jun 1980).

Observations with the Los Alamos Scientific Laboratory/Max-Planck-Institut crossed-fan solar wind ion experiment on ISEE 1 reveal that the solar wind is decelerated and deflected away from the direction of the earth's bow shock as it enters that portion of the upstream region populated by 'diffuse' bow shock ions and long-period (10—60 s) waves. Typically, the average directed velocity vector changes by 7—10 km s^{-1} as it enters the wave region. At times, average speed changes as large as 25—40 km s^{-1} are observed. Superposed upon these changes in average flow speed are large amplitude ($\sim$ +- 15 km s^{-1}) fluctuations in flow speed associated with the waves themselves. The observations suggest that the solar wind deceleration is the result of momentum transfer from 'reflected' bow shock ions to the wind via the long-period waves as the reflected ion beams go unstable. The broad angular distributions of the diffuse ions thus appear to be produced as a consequence of the disruption of reflected ion beams.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 36892

37279 (DOE/ER—0074) **1979 bibliography of atomic and molecular processes.** (Department of Energy, Washington, DC (USA). Div. of Chemical Sciences). Aug 1980. 343p. NTIS, PC A15/MF A01.

This annotated bibliography lists 2146 works on atomic and molecular processes reported in publications dated 1979. Sources include scientific journals, conference proceedings, and books. Each entry is designated by one or more of the 114 categories of atomic and molecular processes used by the Controlled Fusion Atomic Data Center, Oak Ridge National Laboratory, to classify data. Also indicated is whether the work was experimental or theoretical, what energy range was covered, what reactants were investigated, and the country of origin of the first author. Following the bibliographical listing are indexes of reactants and authors.

BEAMS AND THEIR REACTIONS

37280 Equilibrium and propagation of a rotating relativistic electron beam. Sethian, J.D.; Gerber, K.A.; Spector, D.N.; Robson, A.E. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Fluids;* **23**: No. 9, 1880-1887(Sep 1980).

An experimental and theoretical study of a charged, but not current-neutralized, hollow, rotating relativistic electron beam propagating inside a metal tube in the absence of an external magnetic guide field is described. A model has been developed in which the radial equilibrium is derived from the force balance on the beam interacting with its self-field, and the velocity of propagation of the beam is derived from the power balance. The experimental results show close agreement with the predictions of the model.

37281 Trirotron: triode rotating beam radio frequency amplifier . Lebacqz, J. (to Dept. of Energy). US Patent 4,210,845. 1 Jul 1980. Filed date 24 Nov 1978. vpp.

A description is given of a rotating beam radio-frequency amplifier, including: a cylindrical cathode having an outer curved surface for producing electrons; radio-frequency waveguide input means including means for establishing a traveling wave for forming said electrons into a beam and rotating said beam around said cathode; means for adding energy to said beam during said rotation; and output means for extracting the energy of the beam, said input and output means including waveguides that support traveling waves at a frequency that is an intergral multiple of one or more of the frequency of said established traveling wave.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 36921, 37295

37282 Orientation and alignment of the 3p ^{1}P and 4 d ^{1}D levels of neutral helium. Schectman, R.M.; Hight, R.D.; Chen, S.T.; Curtis, L.J.; Berry, H.G.; Gay, T.J.; Deserio, R. (University of Toledo, Toledo, Ohio 43606). *Phys. Rev., A;* **22**: No. 4, 1591-1599(Oct 1980).

The alignment and orientation produced by the tilted-foil excitation of He was studied for a wide range of foil tilt angles and outgoing-atom velocities. In particular, two quantum states of different orbital angular momentum (3p ^{1}P and 4 d ^{1}D) were investigated and the results were compared with a number of previously proposed models.

37283 Molecular beam photoionization study of carbon disulfide, carbon disulfide dimer and clusters. Ono, Y.; Linn, S.H.; Prest, H.F.; Gress, M.E.; Ng, C.Y. (Ames Laboratory, U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *J. Chem. Phys.;* **73**: No. 6, 2523-2533(15 Sep 1980).

A new molecular beam photoionization mass spectrometer which is significantly superior to previous similar instruments in both wavelength resolution and ion intensity is described. Photoionization efficiency (PIE) data for CS_2^+ near the threshold (1210—1232 and 1075—1130 A) were obtained with a resolution of 0.14 A (FWHM). Rydberg series I, n=16—24, which converges to the spin—orbit excited state, ^{2}Pi/sub 1/2/, of CS_2^+ was resolved on the first vibrational step in the PIE data. Observation of the autoionization resonance, series I (n=16), indicates that the value for the first ionization energy (I.E.) for CS_2 obtained in previous absorption experiments (Ref. 23) is too high. The I.E.'s for the ^{2}Pi/sub 3/2/ and ^{2}Pi/sub 1/2/ states of CS_2 were determined to be 10.0685 +- 0.0020 and 10.1230 +- 0.0020 eV, respectively. PIE data for (CS_2)/sub n/$^+$ with n ranging from 2 to 5 have been obtained in the wavelength region from 650 to 1350 A with this apparatus. The observed I.E.'s for $(CS_2)_2$, $(CS_2)_3$, $(CS_2)_4$, and $(CS_2)_5$ are 9.36 +- 0.02, 9.22 +- 0.02, 9.10 +- 0.02, and 9.04 +- 0.02 eV, respectively. From the measured ionization energy, and the estimated dissociation energy (0.05 eV) of $(CS_2)_2$, the binding energy for $CS_2^+ xCS_2$ is deduced to be 17.5 +- 1 kcal/mol. This is in agreement with the value obtained previously in a high pressure mass spectrometry experiment. The Rydberg series for CS_2, which are manifested as autoionization lines in the PIE data for $(CS_2)_2^+$ in the region 850—960 A, are red shifted in energy by $\sim$0.075 eV for Rydberg series III and $\sim$0.14 eV for Rydberg series IV. Adapting the most recent assignment of Rydberg series III and IV by Larzilliere et al. symmetry arguments support a linear or near linear geometry for the carbon disulfide dimer.

37284 R-variation of electronic transition moments from vibrationally crowded spectra: the B—X and D—X transitions of xenon fluoride. Smith, A.L.; Messing, I.; Gelernt, B. (Chemistry Department, Drexel University, Philadelphia, Pennsylvania 19104). *J. Chem. Phys.;* **73**: No. 6, 2618-2625(15 Sep 1980).

Using photographic flash spectroscopy of Xe/F_2 mixtures, we have studied the B(1/2)—X($^2\Sigma^+$) and D(1/2)-X($^2\Sigma^+$) transition of XeF in absorption between 241 and 358 nm. The spectra exhibit extensive sequence crowding due to overlapping hot bands. To determine the R-variation of the B—X and D—X electronic transition moments we use band cluster analysis, in which the R centroids of bands contributing to a given cluster are shown to be similar; i.e., the R centroid is a smoothly varying function of bandhead wavelength. Absolute transition moments are derived by normalizing our relative absorption measurements to the measured radiative lifetime of the v'=0 level of the B(1/2) state. The B—X moment is 2.70 +- 0.22 D, independent of R between 2.30 and 2.54 A. The D—X moment varies linearly from 2.255 D at 2.25 A to 2.413 D at 2.50 A (+- 20%). The computed radiative lifetime of the v'=0 level of the D(1/2) state is 10.0 +- 2.0 nsec.

37285 Structure, properties, and inversion of the Ar$_x$SO$_2$ van der Waals molecule. DeLeon, R.L.; Yokozeki, A.; Muenter, J.S. (Department of Chemistry, University of Rochester, Rochester, New York 14627). *J. Chem. Phys.;* **73**: No. 5, 2044-2048(1 Sep 1980).

Microwave and radiofrequency spectra of the Ar$_x$SO$_2$ van der Waals molecule have been studied by molecular beam spectroscopy. The molecule has C/sub s/ point group symmetry and tunnels through a very low barrier at a C/sub 2v/ structure at a 980 MHz rate. The tunneling interchanges the two oxygen atoms which causes half of each inversion doublet to have zero statistical weight. The inversion frequency and assumptions about the bending vibration lead to a barrier height of $\approx$10 cm^{-1}. Stark effect measurements give μ/sub a/=0.2674 D, μ/sub b/=0.0 D, μ/sub c/=1.465 D. These moments are interpreted in terms of a vibrational amplitude of 24° associated with the inversion coordinate. The geometry of the complex is essentially perpendicular with the Ar atom above the plane of SO_2 and located almost directly over the SO_2 center-of-mass at a 3.675 A distance.

37286 Theoretical characterization of the potential energy surface of the ground state of the HCO system. Dunning, T.H. Jr. (Theoretical Chemistry Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *J. Chem. Phys.;* **73**: No. 5, 2304-2309(1 Sep 1980).

Large scale, ab initio configuration interaction calculations are reported on the ground state potential energy surface of the HCO system. The calculated equilibrium geometry of HCO of R/sub CH/=1.12 A, R/sub CO/=1.19 A, and θ/sub HCO/=126° is in good agreement with that determined experimentally, although the calculated H—CO bond strength D/sub e/=16 kcal/mole is too small by $\sim$3 kcal/mole. A barrier of 7.5 kcal/mole is found for recombination of H+CO; the height of the barrier is estimated to be too large by 5—6 kcal/mole. The COH isomer, with a calculated equilibrium geometry of R/sub OH/=0.98 A, R/sub CO/=1.29 A, and θ/sub COH/=114°, is predicted to lie 40 kcal/mole above the

HCO isomer, or 24 kcal/mole above the H+CO limit. For COH the barrier for dissociation of 16 kcal/mole is substantially less than that for isomerization (29 kcal/mole) in spite of the fact that isomerization is energetically more favorable. The COH isomer has not yet been identified experimentally. For the HCO system there seems to be no significant difference between the variational and perturbation calculations which have been reported, aside from a constant shift in the energy.

37287 Ab initio study of the bonding in diatomic nickel. Noell, J.O.; Newton, M.D.; Hay, P.J.; Martin, R.L.; Bobrowicz, F.W. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **73**: No. 5, 2360-2371(1 Sep 1980).

Hartree—Fock, GVB, and configuration interaction calculations were performed for diatomic nickel using an ab initio effective core potential. A basis set specifically optimized for the ^{3}D state of atomic nickel is found to be far superior to the more common basis obtained from the ^{3}F atomic state. Correlation effects are found to be significant in determining the bond energy. In particular, the two electrons of the s—s bond must be appropriately correlated. In addition, correlation effects which one would interpret as being principally intra-atomic in character are found to have a marked effect on the molecular properties. The theoretically predicted bond dissociation energy (D/sub e/) of 43.4 kcal/mol is significantly lower than the experimental estimate of 55 +- 5 kcal/mol. However, molecular partition functions calculated using the present results indicate that the experimental value should be revised downward to a value of ~46 +- 5 kcal/mol, in good agreement with our calculations. An interatomic distance of 4.27 bohr is computed and compared with experimental estimates. Spectroscopic parameters for dipole-allowed transitions from the ground state were determined from SCF and GVB calculations and discussed in relation to the experimentally observed visible and ultraviolet spectra attributed to Ni_2.

37288 Spectra of very highly charged Cu- and Zn-like ions. Reader, J.; Luther, G. (National Bureau of Standards, Washington, D. C. 20234). *Phys. Rev. Lett.;* **45**: No. 8, 609-613(25 Aug 1980).

The 4s-4p, 4p-4d, and 4d-4f transitions of ten copperlike and zinclike ions from Ba^{26+} to W^{45+} have been observed by means of a laser-produced plasma and a 2.2-m grazing-incidence spectrograph. The spectra are accompanied by a prominent continuum lying just below the $4p^2P$/sub 1/2/-$4d^2D$/sub 3/2/ transitions in the copperlike ions. The results support the identification of the resonance lines of Xe^{24+} and Xe^{25+} in the Princeton University ST tokamak by Hinnov.

37289 Observation of an optical Stark effect on vibrational and rotational transitions. Rahn, L.A.; Farrow, R.L.; Koszykowski, M.L.; Mattern, P.L. (Applied Physics Division, Sandia National Laboratories, Livermore, California 94550). *Phys. Rev. Lett.;* **45**: No. 8, 620-623(25 Aug 1980).

Vibrational and rotational Raman transitions are shown to be shifted to lower frequencies in the presence of a nonresonant, high-intensity optical field. Experimental results using coherent anti-Stokes Raman spectroscopy for hydrogen and nitrogen are presented. The magnitude of the observed shift is in agreement with a calculation which considers the coupling of the optical field to the internuclear separation via the molecular electronic polarizability. The magnitude of the shift is predicted to be proportional to the optical field intensity.

37290 Ab initio prediction of the rotation-vibration spectrum of H_3^+ and D_3^+. Carney, G.D.; Porter, R.N. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev. Lett.;* **45**: No. 7, 537-541(18 Aug 1980).

the first few lines in the P, Q, and R branches of the rotation-vibration spectra of the equilateral-triangle molecular ions H_3^+ and D_3^+, obtained by ab initio nonperturbative calculations, are reported. Comparison with observations indicates an accuracy better than 1% was obtained for both the infrared-active fundamental vibration frequency and the equilibrium internuclear distances.

37291 Hyperfine structure and isotope shift of the 1.3-μm transition of ^{129}I. Engleman, R. Jr.; Keller, R.A.; Palmer, B.A. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Opt.;* **19**: No. 16, 2767-2770(15 Aug 1980).

High resolution Fourier transform spectra of the 1.3-μ emission from ^{127}I and ^{129}I electrodeless discharge lamps are presented and analyzed. The hyperfine splitting constants of ^{129}I are: A=18.35 +- 0.01 mK and B=26.55 +- 0.07 mK for the J=3/2 ground state and A=146.32 +- 0.02 mK for the J=1/2 excited state. The validity of the theoretical intensity and isotope relationships is confirmed. The isotope shift between ^{129}I and ^{127}I for the 1.3-μ transition was measured to be <1 mK.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 36987, 37005

37292 Cluster dynamics: Further classical trajectory studies of A+A/sub n/arrow-right-leftA*/sub n+1/1. Brady, J.W.; Doll, J.D.; Thompson, D.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **73**: No. 6, 2767-2772(15 Sep 1980).

Classical trajectory studies were performed on the dynamics of collisions of single atoms with small clusters of atoms A/sub n/, leading to the formation of quasibound A/sub n+1/* complexes, in an attempt to model the microscopic steps in homogenous nucleation processes. Model systems of atoms representing argon interacting through pairwise Lennard-Jones potentials were used in a three-dimensional numerical simulation of collision events. Capture cross sections and decay rate coefficients were computed as a function of energy for the case in which n equals 5, and the results were combined with previous studies for n equal to 3 and 4 to make preliminary observations about the functional dependence upon cluster size of the forward and reverse rate parameters for this process. Studies were also performed in which opacity functions were calculated for the case where n equals 3 in order to test certain aspects of a simple model frequently used in nucleation studies to compute cluster formation rates.

37293 Study of the reaction dynamics of Li+HF, HCl by the crossed molecular beams method. Becker, C.H.; Casavecchia, P.; Tiedemann, P.W.; Valentini, J.J.; Lee, Y.T. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 6, 2833-2850(15 Sep 1980).

The reactions of (I) Li+HF→LiF+H and (II) Li+HCl→LiCl+H have been studied by the crossed molecular beams method. Angular distributions [$N(\Theta)$] of product molecules have been measured at 4 collision energies (E/sub c/) ranging from about 2 to 9 kcal/mole and time-of-flight (TOF) measurements of product velocity distributions were made at approximately E/sub c/ =3 and 9 kcal/mole for both reactions (I) and (II). The combined $N(\Theta)$ and TOF results were used to generate contour maps of lithium—halide product flux in angle and recoil velocity in the center-of-mass (c.m.) frame. For reaction (I) at E/sub c/=3 kcal/mole the c.m. angular distribution [$T(\theta)$] shows evidence of complex formation with near forward—backward symmetry; slightly favored backward peaking is observed. The shape of this $T(\theta)$ indicates there is significant parallel or antiparallel spatial orientation of initial and final orbital angular momentum. It is deduced that coplanar reaction geometries are strongly favored. At E/sub c/=8.7 kcal/mole the $T(\theta)$ of reaction (I) becomes strongly forward peaked. The product translational energy distributions P(E/sub T/) at both these collision energies give an average E/sub T/ of ~55% of the total available energy. The $T(\theta)$ at E/sub c/=2.9 and 9.2 kcal/mole for reaction (II) are forward—sideways peaked. Most of the available energy (~70%) goes into recoil velocity at both E/sub c/ for LiCl formation. Both reactions (I) and (II) show evidence of no more than a minor partitioning of energy into product vibrational excitation. Integral reactive cross sections (σ/sub R/) are evaluated Values of σ/sub R/ are: for LiF formation σ/sub R/≅0.8 A^2 and 0.94 A^2 at E/sub c/=3 and 8.7 kcal/mole, while for LiCl formation σ/sub R/ = 27 A^2 and 42 A^2 at E/sub c/=2.9 and 9.2 kcal/mole, with estimated absolute and relative uncertainties of a factor of 2, and 30%, respectively.

37294 Role of vibrational—rotational coupling in V—V and V—R,T energy transfer. Coltrin, M.E.; Marcus, R.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *J. Chem. Phys.;* **73**: No. 5, 2179-2181(1 Sep 1980).

The effect of neglecting vibrational—rotational coupling in energy transfer calculations is studied for collisions of HF (v=1-7) with HF (v=0). An analog of a "classical path" method is considered in which rigid-rotor trajectories are used to determine a time-dependent forcing term on the vibrational motion of each molecule. The results are compared with our quasiclassical calculations in which no such approximation was used. At higher vibrational states the rigid-rotor forced-oscillator model is found to predict substantially smaller V—R,T rate constants than those found in the exact study.

37295 Transmission of fast H_2^+ through thin foils. Cue, N.; de Castro-Faria, N.V.; Gaillard, M.J.; Poizat, J.; Remillieux, J.; Gemmell, D.S.; Plesser, I. (Institut de Physique Nucleaire (et Institut National de Physique Nucleaire et de Physique des Particules), Universite Lyon—I, F69622 Villeurbanne, France). *Phys. Rev. Lett.;* **45**: No. 8, 613-617(25 Aug 1980).

Transmission yield of fast H_2^+ through carbon foils has been measured over a wide range of foil thicknesses for 0.4—1.2-MeV/amu H_2^+ projectiles. A model is described which gives an excellent quantitative account of this yield as well as that of the associated H^0 production.

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 37363, 37367

37296 Unified theory of dissociation. Doll, J.D. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **73**: No. 6, 2760-2762(15 Sep 1980).

We present here a unified theory of molecular dissociation. The theory is a generalization of Slater's unimolecular work. Assumptions concerning normal mode behavior are removed and a common formalism suffices for various statistical ensembles. The quantum-mechanical extensions of the theory are immediate.

37297 Localized-muffin-tin-orbital basis for atomic-cluster calculations within the local-density formalism. Harris, J.; Painter, G.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG026. *Phys. Rev., B: Condens. Matter;* **22**: No. 6, 2614-2625(15 Sep 1980).

A new approach for solving the Hohenberg-Kohn-Sham density-functional equations for atomic clusters of moderate size and arbitrary symmetry is described. A basis set is introduced in the spirit of the LCMTO (linear combination of muffin-tin orbitals) method of Andersen with a (phi,phi-dot) form inside each atomic sphere. However, advantageous features of the conventional linear-combination-of-atomic-orbitals method are brought in by introducing only atomiclike orbital tails in the region outside the spheres. The "common-κ" approximation and cellular partitioning of the LCMTO approach are abandoned; with this approach it becomes necessary to carry out some three-dimensional integrations. Techniques are introduced which allow all integrals contributing to the secular matrix and total energy to be evaluated either semianalytically or by the Gaussian integration of smooth functions. Preliminary results for H_2 and O_2 demonstrate the practicality of the scheme.

37298 Theory of selective excitation of multiple-quantum transitions. Warren, W.S.; Weitekamp, D.P.; Pines, A. (Department of Chemistry and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 5, 2084-2099(1 Sep 1980).

The question of whether a molecule can be made to absorb and emit photons only in groups of n is treated. Pulse sequences are introduced which in effect selectively induce the absorption of only groups of n photons. This causes only n-quantum transitions even when many other transitions might be resonant. The technique involves repeated phase shifts of $2\pi/n$ in the radiation to build up the selected coherences and cancel all other coherences, and is applicable to a wide range of spectroscopic systems. Coherent averaging theory is extended to describe selective sequences and demonstrates that n-quantum selectivity is possible to arbitrarily high order in the average Hamiltonian expansion. High-order selectivity requires many phase shifts, however, and for this reason the residual nonselective effects of sequences which are selective to only a finite order are calculated. Selective sequences are applied to the multiple-quantum NMR of oriented molecules, where in combination with time reversal sequences they produce a much more efficient transfer of the population differences into selected coherences than is obtainable by normal wideband pumping. For example, the 10-quantum transition in a 10-spin system can be enhanced by more than four orders of magnitude. Experiments on selective excitaiton of the 4-quantum transitions in oriented benzene verify the expected enhancement.

FLUID PHYSICS

GENERAL FLUID DYNAMICS

37299 (LA—8452-MS) SOLA-STAR: a one-dimensional ICED-ALE hydrodynamics program for spherically symmetric flows. Cloutman, L.D. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 76p. NTIS, PC A05/MF A01.

This report describes a simple, general-purpose, and efficient algorithm for solving one-dimensional spherically symmetric, transient fluid-dynamics problems using a variation of the ICED-ALE technique. Included are the finite difference equations, three test problems that illustrate various capabilities of the program, and a complete code description, including a listing, sample data decks and output, a summary of important variable names, and hints for conversion to other operating systems.

37300 Lennard-Jones triple-point bulk and shear viscosities. Green-Kubo theory, Hamiltonian mechanics, and nonequilibrium molecular dynamics. Hoover, W.G.; Evans, D.J.; Hickman, R.B.; Ladd, A.J.C.; Ashurst, W.T.; Moran, B. (Department of Applied Science, University of California at Davis/Livermore, Livermore, California 94550). W-7405-ENG. *Phys. Rev., A;* **22**: No. 4, 1690-1697(Oct 1980).

A new Hamiltonian method for deformation simulations is related to the Green-Kubo fluctuation theory through perturbation theory and linear-response theory. Numerical results for the bulk and shear viscosity coefficients are compared to corresponding Green-Kubo calculations. Both viscosity coefficients depend similarly on frequency, in a way consistent with enhanced "long-time tails."

37301 Use of artificial viscosity in multidimensional fluid dynamic calculations. Wilkins, M.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 95660). W-7405-ENG-48. *J. Comput. Phys.;* **36**: No. 3, 281-303(15 Jul 1980).

The von Neumann—Richtmyer concept of artificial viscosity that is used in calculating the propagation of shocks was formulated in one space-dimension. A generalization of the method for two and for three space-dimensions is presented here. The basic objectives were to find the one-dimensional equivalent of shock compression that avoided geometric convergence effects and to determine a characteristic grid length. A description is given of a linear viscosity for damping the spurious oscillations that arise when the quadratic von Neumann—Richtmyer artificial viscosity is used. The linear viscosity minimizes the smearing of the shock front. Unwanted distortions that can occur in multidimensional grids are discussed. Results in two and three dimensions are given for the Navier—Stokes-type viscosity developed to damp these distortions.

PROPERTIES AND STRUCTURE OF FLUIDS

37302 Collision and encounter statistics from a molecular dynamics computation on a model of a fused salt. Sundheim, B.R. (Department of Chemistry, New York University, New York, New York 10003). *J. Chem. Phys.;* **73**: No. 5, 2474-2479(1 Sep 1980).

The analysis of collisions (defined as approach within a selected distance) between like and unlike pairs of ions in a computer model of molten KCl is described. The rates of collisions, distribution of encounter lengths, rates of first return and of second return, and the probabilities of escape are reported. These quantities bear on the transient term in diffusion calculations, cage models, fluorescence quenching, and geminate recombination reactions.

MAGNETOHYDRODYNAMICS

37303 (AD-A—079919/7) Magnetogasdynamic phenomena in pulsed MHD flows. Annual summary report 1 oct 78-30 sep 79. Oliver, D.A.; Swean, T.F. Jr; Markham, D.M.; Bangerter, C.D.; Demetriades, S.T. (STD Research Corp., Arcadia, CA (USA)). 1 Oct 1979. Contract N00014-77-C-0574. 66p. NTIS, PC A04/MF A01.

This work is aimed at the understanding, description, and prediction of magnetohydrodynamic phenomena exhibited under conditions of extremely high interaction and large magnetic Reynolds number. The plasmas which constitute the fluid medium in such flows may exhibit nonideal thermodynamic and kinetic behavior. The theoretical work has two principal objectives: the elucidation of basic phenomena in strong interaction high magnetic Reynolds number flows independently of specific experiments or machines, and the perfection of predictive theories to accurately describe and model specific experiments aimed at magnetohydrodynamic power production. In what follows we present the general mathematical description of magnetogasdynamic flows in the high magnetic Reynolds number regime. We present several illustrative calculations of quasi-one-dimensional transient effects in strong interaction flows. Two-dimensional high Reynolds number electricity results are presented including the realistic effects of nonuniform velocity and electrical conductivity resulting from hypersonic boundary layers and from shock-induced nonuniformities.

SUPERFLUIDITY

37304 Variational Monte Carlo calculations of liquid ^{4}He with three-body correlations. Schmidt, K.; Kalos, M.H.; Lee, M.A.; Chester, G.V. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). DE-AC02-76ER03077. *Phys. Rev. Lett.;* **45**: No. 7, 573-576(18 Aug 1980).

The first Monte Carlo calculations explicitly employing triplet correlations in the variational wave function for the ground state of ^{4}He are presented. A significant lowering of energy is obtained, accounting for 75% of the discrepancy between previous Jastrow variational calculations and the known exact numerical results. An improved density dependence of the energy is obtained and the pair correlation function is sharpened leading to much better agreement with the exact ground state.

OTHER QUANTUM FLUIDS

REFER ALSO TO CITATION(S) 37364

37305 Hypernetted-chain Euler-Lagrange equations and the electron fluid. Zabolitzky, J.G. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2353-2372(1 Sep 1980).

Least upper bounds to the ground-state energy of the electron fluid are obtained by solving Euler-Lagrange equations obtained within the framework of Fermi hypernetted-chain theory for arbitrary density and spin polarization. It is shown that the so-obtained approximate distribution and structure functions satisfy known exact relations in the high- and low-density limits as well as in the long-wavelength limit at any density. The numerical results are in excellent agreement with coupled-cluster perturbational and Monte Carlo type calculations. As a by-product a simple analytic solution accurate in the high-density limit is obtained which is superior to the random-phase approximation in the metallic density regime.

HIGH ENERGY PHYSICS

37306 Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978). 924p. (CONF-760874—).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

Individual abstracts were prepared for 21 of the lectures in this volume for entry into the TIC data base; five of these are cited in ERA. Two additional papers have already been entered into the data base; these can be found by reference to the entry CONF-760874— in the Report Number Index. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

WEAK INTERACTIONS

37307 (SLAC-PUB—2529) **Charmonium studies with the crystal ball.** Oreglia, M. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 14p. (CONF-800374—9). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

The Crystal Ball detector at SPEAR is used to analyze the decays psi' → γγpsi and psi' → γchi,chi → γγ. Values are obtained for the branching ratios of psi' → eta/μ^0psi and psi' → γchi,chi → γpsi. No evidence is found for a 2^1S_0(eta'c) state in the mass range 3129 → 3644 MeV/c^2. Analysis of the angular distributions in the cascade chi decays yields spin and multipole assignments for the chi(3.51) and chi(3.55).

37308 Characteristics of $\mu^- e^+ K^0$ events produced by a neutrino beam. Fry, W.F. (Univ. of Wisconsin, Madison). pp 537-553 of Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

A search for new phenomena in neutrino interactions was made in film from the 15-foot bubble chamber exposed to the neutrino horn beam at FNAL. The hydrogen chamber was filled with 20% neon. The procedures and techniques used to select the events, the characteristics of the events, the associated kaon phenomena, and the systematic errors pertinent to the results are discussed in some detail. A surprising characteristic of the events is the large number of K mesons produced. The confirmation of dilepton events in these data strengthens the interpretation as production of a new family of hadrons characterized by a new quantum number. 10 tables. (RWR)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 37310, 37311

37309 $P + P \rightarrow d + \pi^+$ reaction at 0.8 GeV. Nann, H.; Iversen, S.; Kaletka, M.; Hird, J.; Seth, K.K. (Northwestern Univ., Evanston, IL (USA)); Hoistad, B.; Burman, R.L. (Los Alamos Scientific Lab., NM). *Phys. Lett., B;* **88**: No. 3/4, 257-261(Dec 1979).

Differential cross sections and polarization asymmetries for the reaction $p + p \rightarrow d + \pi^+$ have been measured at 0.8 GeV. The data have been analyzed within the formalism of Mandl and Regge, and the results are compared with the recent coupled-channel calculations of Niskanen. It is concluded that at this energy the production of upto f-wave pions is important.

STRONG MESON-INDUCED INTERACTIONS

37310 Production of dimuons by pions and protons at Fermilab. Smith, A.J.S. (Princeton Univ., NJ). pp 701-740 of Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

An experiment to produce $\mu^+\mu^-$ pairs in hadron-hadron collisions is described. Beams of 225-GeV π^+, π^-, and protons were used to bombard C and Sn targets; some data were also taken with 150-GeV π^+ and protons on Be. Features of J/psi production are discussed and compared with the production of the more common vector mesons (rho^0, ω, and phi) and with nonresonant μ pairs in neighboring mass regions. Differential cross sections and mass distributions are presented. The source of single prompt leptons was also studied. 23 figures, 5 tables. (RWR)

37311 Physics with the single arm spectrometer at Fermilab. Cutts, D. (Brown Univ., Providence, RI). pp 741-775 of Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

The single arm spectrometer is fully instrumented for high-energy counter/wire chamber experiments. After a brief description of the spectrometer, data are shown for the inclusive reactions a + p → a + X and a + p → b + X, where a = π^{+-}, K^{+-}, p, or p-bar, and b is different from a. Considerable attention is devoted to the impact analysis of elastic scattering, although inelastic results are also discussed. Cross sections for a number of interactions are compared. Anticipated experiments are outlined. 16 figures, 2 tables. (RWR)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 37321, 37368

37312 Flavor goniometry by proton decay. De Rujula, A.; Georgi, H.; Glashow, S.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-76ER03069. *Phys. Rev. Lett.;* **45**: No. 6, 413-416(11 Aug 1980).

Unification of strong and electroweak forces implies that protons (and bound neutrons) decay. Modes like ν-bar, $e^+\pi$, and μ^+K^0 are expected, while modes like $\mu^+\pi$ and e^+K^0 are "Cabibbo" suppressed. Branching ratios can reveal much about the nature of the unifying group and the origin of fermion masses. Plausible models of unification and flavor mixing give surprisingly different predictions for two-body branching ratios.

ELECTROMAGNETIC INTERACTIONS

37313 Weak and electromagnetic contributions to quark masses. Dine, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., D;* **22**: No. 6, 1473-1477(15 Sep 1980).

We study the lowest-order electromagnetic and weak contributions to quark masses in quantum chromodynamics. We review the arguments that these quantities are ultraviolet divergent in perturbation theory. A suggestion due to Brodsky, Schmidt, and de Teramond, based on a study of the Dyson equation for the quark self-energy, that electroweak corrections are controlled by low-energy physics if the number of quark flavors is greater than 10, is investigated. The meaning of the electromagnetic mass shift defined by these authors is clarified. In models possessing natural relations among quark masses and spontaneous symmetry breakdown the prescription of these authors is shown to lead to the same results as those of conventional analyses. In particular, corrections to these relations remain sensitive to the symmetry-violating scale for any number of quark flavors.

37314 Diquark contributions to scaling violations and to sigma/sub L//sigma/sub T/. Abbott, L.F.; Berger, E.L.; Blankenbecler, R.; Kane, G.L. (Stanford Linear Accelerator Center, CA (USA)). DE-AC03-76SF00515. *Phys. Lett., B;* **88**: No. 1/2, 157-162(Dec 1979).

Arguments for significant dynamical diquark substructure in baryons are reviewed. If present, integer-spin diquarks will absorb longitudinally polarized currents to produce a relatively large value of R = sigma/sub L//sigma/sub T/ in certain kinematic regions of deep-inelastic reactions. We provide single parametrizations for this higher-twist contribution to structure functions and to R. We present fits to the kappa and Q^2 dependences of SLAC-MIT data on electroproduction. Further tests are suggested, and implications are discussed for the interpretation of R in perturbative QCD.

37315 Evaluation of the radiative decay of the vector mesons in the spectrum-generating SU_4 scheme. Amir-Arjomand, S. (Teheran Univ. (Iran). Dept. of Physics); Golestaneh, A.A. (Argonne National Lab., IL (USA)). *Nuovo Cim., A;* **50**: No. 3, 393-404(1 Apr 1979).

The radiative-decay rate formula of the vector mesons is derived on the basis of the SU_4 spectrum-generating group. Due to

the mass symmetry breaking, this formula contains a suppression factor which depends on the mass operator and the transformation properties of the electromagnetic current in the group. In as much as these properties are not known, the suppression factor is determined by the phenomenological method. In doing this, it is noted that no acceptable function can be found which could resolve the differences between the observed and calculated decay rates of rho, ω, phi and psi simultaneously. However, the combination of the SU_4 formalism and the deviation from the ideal mixing between the rho-ω, phi-ω and eta-eta' systems can account for all existing radiative-decay rates, except for the rho→πγ. With this scheme the suppression factor is (m/sub v//sup 2/+m/sub p//sup 2/)$^{-1}$, where m/sub v/ and m/sub p/ are the masses of the vector and pseudoscalar mesons involved in the decay. Reasonable decay rates are predicted for psi→πγ and phi→eta/sub c/γ. However, for the lack of experimental information, a full evaluation of the effect of all mixing processes involved in the psi radiative-decay rates was not possible. The present results suggest that the decay rate for the rho→πγ should be reinvestigated before further theoretical work is attempted.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 37313, 37324

37316 Moments of structure functions and experimental tests of QCD. Harari, H. (Stanford Linear Accelerator Center, CA (USA)). *Nucl. Phys., B;* **161**: No. 1, 55-60(Dec 1979).

Simple assumptions, which have little or no connection to quantum chromodynamics, lead to upper and lower bounds for the slope of the graph for log M/sub N/ versus log M/sub N/, where M/sub N/ is the Nth moment of the deep inelastic structure function $xF_3(x, q^2)$. The published results of the CDHS and BEBC collaborations cover the entire range allowed by our bounds and therefore cannot be considered as evidence for the validity of QCD.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 37324

37317 Short distance counting rules for low p/sub T/ fragmentation. Gunion, J.F. (California Univ., Davis (USA). Dept. of Physics). *Phys. Lett., B;* **88**: No. 1/2, 150-156(Dec 1979).

Recent experimental data provide evidence in favor of a model in which hadronic collisions are initiated by a factorizing mechanism, such as gluon exchange. We propose that fast fragments resulting from such collisions arise via quantum chromodynamic diagrams in which the required quarks and/or antiquark are produced in 'point-like' fashion; these can be shown to be the leading diagrams as x, the momentum fraction of the secondary hadron, approaches 1. We obtain good agreement with the observed power law behaviors, dN/dx prop. to (1-x)/sup n/, of single particle low p/sub T/ spectra.

STRONG INTERACTIONS, BARYON NO.=0

37318 Can pedestrians understand the new particles. Lipkin, H.J. (Weizmann, Inst. of Science, Rehovot, Israel). pp 179-254 of Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

The narrowness of the psi particles is usually attributed to the Okubo-Zweig-Iizuka (OZI) rule, but this rule is not well understood. Questions regarding the theoretical validity and possible experimental tasks of the OZI rule are addressed. The subject is developed in the following manner: the SU(6) bandwagon; the search for new degrees of freedom; the present status of the new particles and the OZI rule; the Okubo-Zweig-Iizuka rule (pedagogical examples and some basic questions; symmetry, dynamics, mixing, and the K_1-K_2 analogy; a dynamic model for selection rules at the SU(3) level; the quark line selection rules; the higher-order and unitarity paradoxes; a simple SU(3) model; the selection rule in SU(6)/sub W/ symmetry; ideal mixing and symmetry cancelations; cancelations and degeneracies in quark line models; quantitative estimate of OZI violation; experimental tests of the OZI rule; and applications of the OZI rule to the new particles); why narrow continuum states are interesting; and strangeness and baryon number. 15 figures, 2 tables. (RWR)

GENERAL

REFER ALSO TO CITATION(S) 37321, 37322

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 37312

FIELD THEORY

REFER ALSO TO CITATION(S) 37313, 37316, 37317, 37351

37319 Finite-temperature behavior of the lattice abelian Higgs model. Banks, T. (Institute for Advanced Study, Princeton, NJ (USA); Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Rabinovici, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Hebrew Univ., Jerusalem (Israel). Dept. of Physics). *Nucl. Phys., B;* **160**: No. 2, 349-379(Dec 1979).

We study phase transitions in the lattice version of the abelian Higgs model, a model which can exhibit both spontaneous symmetry breaking and confinement. When the Higgs charge is the basic U(1) unit, we find that the Higgs and confinement regions are not separated by a phase transition and form a single homogenous phase which we call the total screening phase. The model does not undergo a symmetry restoring phase transition at finite temperature. If the Higgs charge is some multiple of the basic unit the model follows the conventional wisdom: there are 3 phases (normal, Higgs and confinement) at zero temperature, two of which disappear above some critical point. We apply the lessons learned from the lattice Higgs model to understand the behavior of the weak interactions at high temperature. In a long appendix we give an intuitive physical picture for the Polyakov-Susskind quark liberating phase transition and show that it is related to the Hagedorn spectrum of a confining model. We end with a collection of effective field theory approximations to various lattice theories.

37320 (SLAC-PUB—2584) Suppression of superheavy magnetic monopoles in grand unified theories. Pi, S.Y. (Stanford Linear Accelerator Center, CA (USA)). Aug 1980. Contract AC03-76SF00515. 4p. (CONF-800724—26). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The superheavy magnetic monopoles predicted by grand unified theories would not be produced in significant numbers if electromagnetic gauge invariance is spontaneously broken when the temperature T is greater than T/sub c/ $>\sim$ 1 TeV.

37321 Dynamical theory of subconstituents based on ternary algebras. Bars, I.; Guenaydin, M. (Physics Department, J. W. Gibbs Laboratory, Yale University New Haven, Connecticut 06520). EY-76-C-02-3075. *Phys. Rev., D;* **22**: No. 6, 1403-1413(15 Sep 1980).

We propose a dynamical theory of possible fundamental constituents of matter. Our scheme is based on (super) ternary algebras which are building blocks of Lie (super) algebras. Elementary fields, called "ternons," are associated with the elements of a (super) ternary algebra. Effective gauge bosons, "quarks," and "leptons" are constructed as composite fields from ternons. We propose two- and four-dimensional (super) ternon theories whose structures are closely related to CP/sub N/ and Yang-Mills theories and their supersymmetric extensions. We conjecture that at large distances (low energies) the ternon theories dynamically produce effective gauge theories and thus may be capable of explaining the present particle-physics phenomenology. Such a scenario is valid in two dimensions.

37322 Vacuum symmetry structure in quantum chromodynamics. Palmer, W.F.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). EY-76-C-02-1545. *Phys. Rev., D;* **22**: No. 6, 1437-1440(15 Sep 1980).

The quantum-chromodynamic vacuum is described in terms of additional angles associated with chiral SU(N) vacuum degeneracy and the phases of the quark mass matrix. This description helps to remove certain ambiguities associated with instantons, chiral SU(N) breaking, and the U(1) problem. It is verified that the chiral Ward identities are consistently satisfied in the presence of chiral SU(N) breaking without the need of a "ninth" massless pseudoscalar meson.

37323 Effective potential for a renormalized d-dimensional gphi^4 field theory in the limit g→∞. Bender, C.M.; Cooper, F.; Guralnik, G.S.; Moreno, H.; Roskies, R.; Sharp, D.H. (Department of Physics, Washington University, St. Louis, Missouri 63130). *Phys. Rev. Lett.;* **45**: No. 7, 501-504(18 Aug 1980).

The first four coefficients in the effective potential V/sub eff/(phi/sub R/)=Σ/sup infinity//sub n/=1V/sub 2n/phi/sub R/ /sup 2n/ are calculated for a mass- and wave-function-renormalized gphi^4 field theory in d space-time dimensions in the limit where the unrenormalized coupling g→∞ with the renormalized mass M held fixed. The accuracy of these numerical results is verified by exact analytical calculations of the effective potential performed in 0 and 1 space-time dimensions.

37324 Crossover from weak to strong coupling in SU(N) lattice gauge theories. Kogut, J.B.; Shigemitsu, J. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). EY76-S-02-2220. *Phys. Rev. Lett.;* **45**: No. 6, 410-413(11 Aug 1980).

Coupling constant renormalization for SU(N) lattice gauge theories is studied with Hamiltonian methods. Expansions to $O(g^{-16})$ suggest that the crossover from weak to strong coupling occurs progressively more abruptly in the variable $\lambda^2 = g^2N$ as N increases. The constants relating the string tension to the scale-breaking parameter Λ are estimated for all N. It is suggested that the Callan-Symanzik β function develops a kink in the $N \to \infty$ limit at a nonzero value of λ^2.

SCATTERING THEORY

37325 Fourier-Bessel representation for $1/r^2$ potentials. Friar, J.L.; Wallace, S.J. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **22**: No. 4, 1802-1805(Oct 1980).

An exact Fourier-Bessel impact parameter amplitude S/sub F/(b) is given in the form of a quadrature for the case of nonrelativistic scattering by a $1/r^2$ potential. The only other potential for which S/sub F/(b) is known is the Coulomb potential. An asymptotic expansion of the exact S/sub F/(b) reproduces eikonal expansion results. For small impact parameter, the exact S/sub F/(b) is not correctly represented by the eikonal expansion series due to the $1/r^2$ singularity of the potential. Perturbation theory results are also presented.

PHYSICS RESEARCH

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

37326 Evidence for pion exchange currents in the analysis of the ^{4}He(p,d)^{3}He reaction at intermediate energies. Shepard, J.R.; Rost, E.; Smith, G.R. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). *Phys. Lett., B;* **89**: No. 1, 13-16(Dec 1979).

Previous unsuccessful analyses of ^{4}He(p,d)^{3}He at intermediate energies have employed densities based directly on the measured $e^- + {}^4$He elastic scattering. When the effects of pion exchange currents are removed, the resulting DWBA analysis is in qualitative agreement with the experimental data.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 37343

NUCLEAR REACTIONS AND SCATTERING

37327 Pion-helium scattering above the (3,3) resonance. Kaellne, J.; Davis, J.F.; McCarthy, J.S.; Minehart, R.C.; Whitney, R.R.; Boudrie, R.L.; McClelland, J.; Stetz, A. (University of Virginia, Charlottesville, Virginia 22901). *Phys. Rev. Lett.;* **45**: No. 7, 517-520(18 Aug 1980).

Differential cross sections are reported for π^+ +/sup 3,4/He elastic scattering at 260, 295, and 310 MeV and π^- +/sup 3,4/He at 295 MeV. The angular distributions)except for $\pi^- + {}^3$He) confirm the fixed angle ($\theta \approx 75^0$) minimum seen at lower energies [caused by the (3,3) π+N resonance dominance] and show a deep minimum at $\theta \approx 110^0$. Comparisons are made to π+d and the current discussion of pion excitation of intermediate dibaryon and ΔN states.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 37328

NUCLEAR REACTIONS AND SCATTERING

37328 Excitation of non-normal parity states by pion scattering: Application to ^{13}C. Lee, T.H.; Kurath, D. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., C;* **22**: No. 4, 1670-1679(Oct 1980).

General features are calculated for excitation of non-normal parity states in pion scattering on 1p-shell targets. Detailed distorted-wave impulse approximation results are given for ^{13}C and related to effects of nuclear structure. Approximate formulas are deduced and applied to the region of excitation energy from 10 to 23 MeV. Calculations for (e,e') in this region are included.

37329 Isospin dependence of the Δ-spreading potential. Karaoglu, B.; Karapiperis, T.; Moniz, E.J. (Center for Theoretical Physics, Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-76ER03069. *Phys. Rev., C;* **22**: No. 4, 1806-1808(Oct 1980).

The ratio of near-resonance inclusive π^{+-} scattering cross sections from the isotopic pair /sup 16,18/O is shown to be consistent with an isospin dependence of the Δ-spreading potential determined by intermediate coupling to the pion absorption channel.

37330 Microscopic description of nucleon-nucleus total reaction cross sections. DiGiacomo, N.J.; DeVries, R.M.; Peng, J.C. (Physics Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **45**: No. 7, 527-531(18 Aug 1980).

Microscopic calculations of the total reaction cross sections for protons on ^{12}C, ^{27}Al, ^{40}Ca, and ^{208}Pb, and neutrons on ^{27}Al and ^{208}Pb have been made, which provide for the first time an excellent description of the data for projectile energies from 15 MeV through 1 GeV. The calculations are based on the experimental nucleon-nucleon total cross sections and explicitly include the effects of the real nuclear potential, the Coulomb potential, Pauli blocking, and Fermi motion.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 37332

37331 Isospin mixing of 4^- particle-hole states in ^{16}O. Holtkamp, D.B.; Braithwaite, W.J.; Cottingame, W.; Greene, S.J.; Joseph, R.J.; Moore, C.F.; Morris, C.L.; Piffaretti, J.; Siciliano, E.R.; Thiessen, H.A.; Dehnhard, D. (University of Texas, Austin, Texas 78712). *Phys. Rev. Lett.;* **45**: No. 6, 420-423(11 Aug 1980).

Transitions to (4^-,T=0) states in ^{16}O at 17.79 and 19.80 MeV are found to be strongly asymmetric in π^+ vsπ^- inelastic scattering; in contrast, the π^+ and π^- cross sections for the (4^-,T=1) state at 18.99 MeV are equal. Three-state isospin mixing is proposed as an explanation. Off-diagonal charge-dependent mixing matrix elements of -147 +- 25 and -99 +- 17 keV are obtained.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37310, 37331

37332 Cross sections for the ^{6}Li(^{3}He,p) reaction at energies below 2 MeV. Elwyn, A.J.; Holland, R.E.; Davids, C.N.; Monahan, J.E.; Mooring, F.P.; Ray, W. Jr. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., C;* **22**: No. 4, 1406-1419(Oct 1980).

Absolute cross sections for the ^{6}Li(^{3}He,p) reaction to the ground, 2.94-, 16.63-, and 16.92-MeV states in ^{8}Be, as well as for the total underlying proton continuum, have been obtained for incident ^{3}He energies between ~0.5 and 1.85 MeV. Differential and total (integrated) reaction cross sections with accuracies of 10 —20 % are presented. Thermonuclear reaction-rate parameters are calculated. Interpretation of the observed proton and alpha particle continuous spectra is discussed.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

REFER ALSO TO CITATION(S) 37330

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 37335

37333 Measurement of the ^{32}Si half-life via accelerator mass spectrometry. Kutschera, W.; Henning, W.; Paul, M.; Smither, R.K.; Stephenson, E.J.; Yntema, J.L.; Alburger, D.E.; Cumming, J.B.; Harbottle, G. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **45**: No. 8, 592-596(25 Aug 1980).

The half-life of ^{32}Si has been measured to be T/sub 1/2/ =101 +- 18 yr, considerably shorter than the previously accepted value of ≈300 yr. The new value was obtained by measuring the specific β activity with a liquid—scintillation-counter technique and the ^{32}Si concentration with tandem-accelerator mass spectrometry. It is expected that the present result will have a strong impact on studies with cosmogenic ^{32}Si.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 37335

MOMENTS AND SPIN

37334 Magnetic moment of /sup 24m/Na. Murnick, D.E.; Gibbs, H.M.; Wood, O.R. II (Bell Labs., Murray Hill, NJ (USA)); Zamick, L. (Rutgers - the State Univ., New Brunswick, NJ (USA)); Pappas, P.; Burns, M. *Phys. Lett., B;* **88**: No. 3/4, 242-244(Dec 1979).

Recent experiments have provided values for the magnetic moment of the 1^+ isomer of ^{24}Na. We have determined the sign of the moment to be negative by a laser-induced nuclear orientation experiment and have compared the experimental results with calculations based on the Lawson-Nilsson model.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37345

37335 Test of the isobaric multiplet mass equation from β-delayed proton decay of ^{24}Si. Ledebuhr, A.G.; Harwood, L.H.; Robertson, R.G.H.; Bowles, T.J. (Cyclotron Laboratory and Department of Physics, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev., C;* **22**: No. 4, 1723-1728(Oct 1980).

The highly proton-rich nucleus ^{24}Si has been produced via the ^{24}Mg(^{3}He,3n) reaction. The half-life of ^{24}Si was found to be 103(42) ms, and the energy of the protons de-exciting the T=2 state in the daughter, ^{24}Al, has been measured as 3912.7(37) keV. From detailed consideration of masses in the A=24 isobaric quintet (recently completed), it is concluded that this quintet constitutes a test of the isobaric multiplet mass equation as precise as the mass 9 quartet and that there is, in this case, no significant departure from the equation.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

REFER ALSO TO CITATION(S) 37330

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37345

37336 Single-particle spectra associated with high-multiplicity events in 800-MeV/nucleon Ar on KCl and Pb. Nagamiya, S.; Lemaire, M.; Schnetzer, S.; Steiner, H.; Tanihata, I. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev. Lett.;* **45**: No. 8, 602-605(25 Aug 1980).

High-multiplicity events were selected in collisions of 800-MeV/nucleon Ar on KCl and Pb. In these events, projectile fragments are highly suppressed, and the angular distributions of high-energy protons are almost isotropic in a moving frame whose rapidity is y_0(y_0≈0.60 for KCl and 0.43 for Pb targets). Comparisons with inclusive proton data are used to estimate the the relative importance of single and multiple NN collisions. Pion spectra in high-multiplicity events are also presented.

37337 Dependence of isobaric charge distributions on energy loss and mass asymmetry in damped collisions. Mignerey, A.C.; Viola, V.E. Jr.; Breuer, H.; Wolf, K.L.; Glagola, B.G.; Birkelund, J.R.; Hilscher, D.; Huizenga, J.R.; Schroeder, W.U.; Wilcke, W.W. (Department of Chemistry and Cyclotron Laboratory, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.;* **45**: No. 7, 509-512(18 Aug 1980).

Yields for specific Z and A have been measured for projectilelike fragments produced in the reaction of 8.3-MeV/u ^{56}Fe ions with targets of ^{56}Fe, ^{165}Ho, and ^{238}U. Variances of the isobaric charge distributions σ/sub Z/ ^{2}(A) reveal a saturation value of σ/sub Z/ ^{2}(A)≈0.8, reached within the first 30—50 MeV of energy loss depending on target. Variances of the isotopic mass distributions saturate at a value of σ/sub A/ ^{2}(Z)≈2-4, which is reached after about 60—80 MeV of energy loss. The data are compared with N/Z equilibrium models.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

37338 Angular momentum transfer in the reactions induced by 166 MeV ^{20}Ne on ^{63}Cu. Dayras, R.A.; Stokstad, R.G.; Hensley, D.C.; Halbert, M.L.; Sarantites, D.G.; Westerberg, L.; Barker, J.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., C;* **22**: No. 4, 1485-1508(Oct 1980).

A study has been made of the energy, angular, and charge distribution of products emitted in the reaction of 166-MeV ^{20}Ne ions with ^{63}Cu. The first three moments of the γ-ray multiplicity distribution and the out-of-plane γ-ray angular correlations have been measured in coincidence with the projectilelike fragments. Relaxation times of 2.6 x 10^{-22} s for energy dissipation, 4.1 x 10^{-23} s for angular momentum transfer, and a charge diffusion coefficient of 0.58 x 10^{22} (charge units)^2 s^{-1} have been deduced from these data. A small γ-ray anisotropy and a large width of the multiplicity distribution have been observed. These are interpreted in terms of a random component of transferred angular momentum whose magnitude is comparable to that of the aligned component induced by tangential friction. Thermal excitation of collective modes of motion in the equilibrated dinuclear complex can account quantitatively for these experimental results. Other mechanisms for the generation of a random component of angular momentum are also possible.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 37342

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37310

37339 Charge distributions for the ^{86}Kr+^{139}La system at 505, 610, and 710 MeV. Dyer, P.; Webb, M.P.; Puigh, R.J.; Vandenbosch, R.; Thomas, T.D.; Zisman, M.S. (University of Washington, Seattle, Washington 98195 and Michigan State University, East Lansing, Michigan 48824). *Phys. Rev., C;* **22**: No. 4, 1509-1521(Oct 1980).

Nuclear charge distributions for projectilelike and fission-fragment-like reaction products were measured as a function of angle and energy loss at each of the three bombarding energies E/sub L/ =505, 610, and 710 MeV for the ^{86}Kr+^{139}La reaction. The charge distributions at most angles and energy losses are dominated by a peak centered close to the Z of the projectile. The variances of the Z distributions of this component exhibit a different dependence on energy loss at each of the three bombarding energies. A nucleon-exchange model incorporating the effects of the Fermi motion and Pauli Principle is quite successful in accounting for the rate of energy loss per exchange deduced from the charge distribution data. This result suggests that nucleon exchange is the major mechanism for energy dissipation in these collisions. The data are also analyzed in the framework of a phenomenological model from which diffusion constants are obtained. For large energy losses a second peak appears in the charge distribution with a most probable Z equal to one half the sum of the projectile and target Z. This component is attributed to fusion-fission. The magnitude of the fusion-fission cross section at 505 and 610 MeV is larger than time-dependent Hartree Fock predictions.

37340 Direct evidence for a narrow window at high angular momentum in incomplete-fusion reactions. Barker, J.H.; Beene, J.R.; Halbert, M.L.; Hensley, D.C.; Jaeaeskelaeinen, M.; Sarantites, D.G.; Woodward, R. (Department of Physics, St. Louis University, St. Louis, Missouri 63103). *Phys. Rev. Lett.;* **45**: No. 6, 424-427(11 Aug 1980).

Alpha-gamma coincidence measurements have been made with reactions of 142-MeV ^{16}O on ^{146}Nd leading to the noncollective nuclei ^{153}Dy and ^{151}Dy. The side-feeding pattern in coincidence with forward energetic alpha particles peaks at J=30 with full width at half maximum ~10, indicating that central collisions do not participate, while that for backward alpha particles extends down to J=0. The data are consistent with the generalized critical-angular-momentum model of incomplete fusion.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 37340

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37337

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

37341 Microscopic structure of the magnetic high-spin states in ^{209}Pb. Krewald, S.; Speth, J. (Institut fuer Kernphysik, Kernforschungsanlage Juelich, D-5170 Juelich, West Germany). EY-76-S-02-3001. *Phys. Rev. Lett.;* **45**: No. 6, 417-419(11 Aug 1980).

Consideration of both the effect of the one-pion and p-meson exchange potentials in the particle-hole interaction and the inclusion of 2p-2h configurations explains why the magnetic high-spin states discovered recently in ^{209}Pb are close to the shell-model energies although the cross sections are only 50% of the single-particle estimate.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37330, 37341

37342 Time-dependent Hartree-Fock studies of the scattering of Kr ions from Pb, Bi and La. Davies, K.T.R. (Oak Ridge National Lab., TN (USA)). pp 185-193 of Time dependent Hartree Fock method. Orsay; Saclay, 1979. Bonche, P.; Giraud, B.; Quentin, P. (eds.). Orsay, France; Editions de Physique (1979).

From Workshop on time dependent Hartree Fock method; Orsay; Saclay, France (28 May - 1 Jun 1979).

Time-dependent Hartree-Fock calculations have been performed for the reactions ^{84}Kr+^{208}Pb at E(lab)=494 MeV, ^{84}Kr+^{209}Bi at E(lab)=600 and 714 MeV, and ^{86}Kr+^{139}La at E(lab)=505, 610 and 710 MeV. The model used is the two-dimensional rigid clutching approximation. In the reactions ^{84}Kr+^{208}Pb at E(lab)=494 MeV and ^{84}Kr+^{209}Bi at E(lab)=600 MeV the final scattering angles, kinetic energies, and mean masses are in good agreement with experiment, but the calculated mass and charge distribution widths are an order of magnitude smaller than the experimental values. For ^{84}Kr+^{209}Bi at E(lab)=714 MeV and for ^{86}Kr+^{139}La at all three energies there are other discrepancies; e.g. the large angle (small angular momentum) fully damped events are about 50 MeV higher than the experimental ridges on the Wilczynski plots. For ^{86}Kr+^{139}La, a fusion energy threshold is observed, with fusion found at E(lab)=710 MeV but not at E(lab)=505 and 610 MeV; also at E(lab)=710 MeV alpha-particle-like emission from the neck at scission is observed for a small range of angular momenta near 100h-bar.

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37336

37343 Determination of the asymptotic ratio of the deuteron D- and S-state amplitudes. Stephenson, K.; Haeberli, W. (University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev. Lett.;* **45**: No. 7, 520-523(18 Aug 1980).

The value 0.026 49 +- 0.000 43 is deduced for the deuteron asymptotic D- to S-state ratio from measurements of the ^{208}Pb(d,p)^{209}Pb tensor analyzing powers at sub-Coulomb bombarding energies E/sub d/=7, 8, and 9 MeV. The quoted uncertainty includes statistical errors, beam-polarization measurement errors, and systematic errors which result from a choice of optical-model parameters used to describe the reaction. The result is conpared to several theoretical deuteron wave functions.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 37337

37344 (CONF-800979—2) **Evaluation of neutron cross sections for fissile and fertile nuclides in the keV range.** Weston, L.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

Procedures for evaluation of radiative capture, elastic and inelastic processes, and fission in the keV region of neutron energies are described. The use of theoretical tools along with the available ENDF utility codes allows the evaluator to extend and expand upon the experimental data, which are often sparse or discrepant. A few problems with the utility codes are noted, and suggestions, made for improvement and extension. Some ENDF/B-V cross sections for important nuclei are plotted in detail, and show significant need for improvement in the shape of the individual partial cross sections to be consistent with theoretical predictions within the constraints of the experimental data. In particular, uranium and plutonium isotopic evaluations, which are of critical importance to fast reactors, deserve careful attention with improved methodology. 8 figures.

37345 (DOE/ER/01505—95) **Deexcitation processes in nuclear reactions.** Porile, N.T. (Purdue Univ., Lafayette, IN (USA)). Aug 1980. Contract AS02-76ER01505. 27p. NTIS, PC A03/MF A01.

The following studies, currently in progress, are discussed: angular distributions and differential ranges of Ba fragments from the interaction of ^{238}U with 0.8-to 400- GeV protons; target A dependence of the angular distribution of Sc fragments emitted in 400-GeV proton interactions; energy spectra of isotopically resolved fragments emitted in high-energy proton interactions with noble gases; comparative study of fragments emission in the interaction of Cu-U with relativistic ^{12}C ions and high-energy protons; excitation functions of the ^{127}I(π^{+-},π^{+-} xn) reactions. 7 figures.

SPONTANEOUS AND INDUCED FISSION

37346 (CONF-801107—8) **Absolute measurement of anti ν for ^{252}Cf.** Smith, J.R.; Reeder, S.D.; Gehrke, R.J. (EG and G Idaho, Inc., Idaho Falls (USA); Idaho National Engineering Lab., Idaho Falls (USA); Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 3p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Neutron yields were determined by measuring the activities produced in the INEL manganese bath. Of the three fission methods used, the neutron-fission coincidence method was found to be the most consistent and reliable. The value of ^{252}Cf anti ν obtained by these measurements was 3.764. (RWR)

37347 Fragment mass and kinetic-energy distributions from spontaneous fission of the neutron-deficient isotopes, 1.2-s ^{246}Fm and 38-s ^{248}Fm. Hoffman, D.; Lee, D.; Ghiorso, A.; Nurmia, M.; Aleklett, K. (Chemistry-Nuclear Chemistry Division, MS-760, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., C;* **22**: No. 4, 1581-1584(Oct 1980).

We have measured the mass and kinetic-energy distributions for fragments from the spontaneous fission of 1.2-s ^{246}Fm and 38-s ^{248}Fm. The mass distributions are highly asymmetric and the average total kinetic energies of 199 +- 4 MeV and 198 +- 4 MeV, respectively, are consistent with systematics for lower Z actinides. Their properties are in contrast to those of ^{258}Fm and ^{259}Fm, whose spontaneous fission results in narrowly symmetric mass distributions accompanied by unusually high total kinetic energies.

37348 Coalescence of light particles in the reaction ^{16}O+^{238}U at 315 MeV. Awes, T.C.; Gelbke, C.K.; Poggi, G.; Back, B.B.; Glagola, B.; Breuer, H.; Viola, V.E. Jr.; Symons, T.J.M. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Phys. Rev. Lett.;* **45**: No. 7, 513-516(18 Aug 1980).

The energy spectra of light particles (p,d,t) produced in ^{16}O-induced reactions on ^{238}U at 315 MeV can be rather well described by thermal distributions in a rest frame that moves with about half the beam velocity. The energy spectra of deuterons and tritons can be related to the proton energy spectra by a coalescence model that incorporates Coulomb effects.

NUCLEAR THEORY

NUCLEAR MATTER

37349 Stable phase of nuclear matter. Kohmura, T.; Tezuka, H. (Institute of Physics, University of Tsukuba, Ibaraki, Japan). *Phys. Rev., C;* **22**: No. 4, 1778-1786(Oct 1980).

A model of nuclear matter composed of nucleons interacting with neutral scalar mesons and neutral vector mesons, which Walecka has shown in the classical field approximation to reproduce the nuclear saturation property, is studied. The Fermi gas state for the system is shown to be unstable, resulting in the equidistant multilayer structure, a new phase of the system in which nucleons are distributed in multiple layers spaced equidistantly. In this structure, the energy per nucleon is E/N=-24 MeV and the nucleon density is rho=0.02rho$_0$ with the normal nucleon density rho$_0$. It is pointed out that the saturation property of a nucleon system, as well as the exchange term for nuclear interactions should be of considerable consequence in the discussion of the instability of nuclear states.

37350 Extrapolation of the phenomenological nuclear equation of state to high densities. Bludman, S.A.; Dover, C.B. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania

19104). EY-76-C-02-0016. *Phys. Rev., D;* **22**: No. 6, 1333-1336(15 Sep 1980).

We propose a modification of the phenomenological Skyrme interaction in order to obtain a nuclear equation of state fitted to the binding energy, saturation density, and incompressibility of nuclear matter and which remains causal at higher densities. The properties of this and other equations of state at transnuclear densities are compared and the implications for stellar collapse and cold neutron structure are briefly discussed.

NUCLEAR REACTIONS AND SCATTERING

37351 Field theoretic extensions of TDHF techniques. Campbell, D.K. (Los Alamos Scientific Lab., NM (USA)). pp 218-227 of Time dependent Hartree Fock method. Orsay; Saclay, 1979. Bonche, P.; Giraud, B.; Quentin, P. (eds.). Orsay, France; Editions de Physique (1979).

From Workshop on time dependent Hartree Fock method; Orsay; Saclay, France (28 May - 1 Jun 1979).

The aim is to formulate and study numerically a relativistic quantum field theoretic generalization of TDHF in the context of high-energy heavy ion collisions. Not only are the nuclear velocities approaching values at which the effects of relativistic kinematics may be important, but also the copious production of mesons, particularly pions, suggests that the existence of mesons as fundamental dynamical degrees of freedom, both carriers of the nuclear force and particles capable of being produced in collisions, can not be ignored. Although one might hope to 'patch up' the kinematics and to approximate meson production by introducing a coupled channel formulation, clearly a more fundamental approach is to take the giant step of seeking a TDHF-like approximation to relativistic quantum field theories, since such theories automatically incorporate the desired effects. Unfortunately, the complexities of quantum field theory tax our calculational abilities to the extent that we are forced to consider very simplified, and consequently physically unrealistic, models. 'Unrealistic', however, is not the same as 'uninteresting', and we shall see in the simple model described many interesting effects, some of which will surely survive in more realistic models.

37352 Polarizations in heavy-ion-induced transfer reactions. Bond, P.D. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., C;* **22**: No. 4, 1539-1549(Oct 1980).

Semiclassical approximations are used in the distorted-wave Born approximation to derive expressions for expected polarizations in heavy-ion-induced transfer reactions. The signs and magnitudes of these polarizations are shown to depend upon a few crucial, easily estimated, parameters and also upon the specific final states populated. Comparison of distorted-wave Born-approximation calculations to data is made.

37353 Analytical approximation to pion-nucleus scattering near the (3,3) resonance. Germond, J.; Johnson, M.B. (Institut de Physique, Neuchatel, Switzerland). *Phys. Rev., C;* **22**: No. 4, 1622-1631(Oct 1980).

Starting from the eikonal approximation to the scattering amplitude an analytical approximation is obtained, including Coulomb effects. The amplitude is characterized by three numbers, one of which is a radius parameter b_1. These numbers are related in a simple way to the optical potential U(r) for $r \cong b_1$. The quality of the analytical result is assessed by comparing it to the exact eikonal amplitude for a model of U which is linear in density. It reproduces accurately the position and depth of the first minimum, the magnitude of the first secondary maximum, and the differences of the π^+ and π^- cross sections. It is furthermore shown that at 180 MeV the analytical approximation reproduces semiquantitatively the magnitude and shape of the "model exact" solution of the Klein-Gordon equation at forward angles. An application to scattering by the calcium isotopes is taken as an example to show the sensitivity to the neutron distribution as the f/sub 7/2/ shell is filled.

37354 Coupled channel theory of pion-nucleus reactions. Koltun, D.S.; Mizutani, T. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). EY-76-S-02-2171. *Phys. Rev., C;* **22**: No. 4, 1657-1669(Oct 1980).

A theory of nuclear reactions induced by pions is presented, which includes scattering and absorption on an equal footing. The theory is consistent with a quantum field theory of mesons, but is developed in an effective Schroedinger equation formulation, to be consistent with conventional multiple scattering methods which are here extended. Methods of application to practical calculations are discussed.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 37353

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 37295

37355 (LA—8498-MS) SENSIT: a cross-section and design sensitivity and uncertainty analysis code. Gerstl, S.A.W. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 134p. NTIS, PC A07/MF A01.

SENSIT computes the sensitivity and uncertainty of a calculated integral response (such as a dose rate) due to input cross sections and their uncertainties. Sensitivity profiles are computed for neutron and gamma-ray reaction cross sections (of standard multigroup cross-section sets) and for secondary energy distributions (SED's) of multigroup scattering matrices. In the design sensitivity mode, SENSIT computes changes in an integral response due to design changes and gives the appropriate sensitivity coefficients. Cross-section uncertainty analyses are performed for three types of input data uncertainties: cross-section covariance matrices for pairs of multigroup reaction cross sections, spectral shape uncertainty parameters for secondary energy distributions (integral SED uncertainties), and covariance matrices for energy-dependent response functions. For all three types of data uncertainties, SENSIT computes the resulting variance and expected standard deviation in an integral response of interest, on the basis of generalized perturbation theory. SENSIT uses angular-flux files from one-dimensional discrete-ordinates codes like ONETRAN, ANISN, and DTF, and reads multigroup cross-section sets in three different formats. This report gives detailed input specifications; precise definitions of all input and output arrays; a discussion of the underlying theory; and details of program flow, data management, and storage requirements. Eight sample problems are described in detail for which complete input files and selected output prints are listed. 4 figures, 3 tables.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 37355

37356 (CONF-801107—7) Albedo technique for dose rates in cylindrical annular voids. McCracken, R.T.; Grimesey, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 15p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The angle-dependent albedo formula of French and Wells is combined with the albedo dose rate kernel and the resulting expression is integrated around the cylindrical surfaces representing the pressure vessel and primary shielding. The result is the dose rate above the annulus due to emergent neutrons streaming in the annulus adjacent to the pressure vessel.

37357 (DOE/EV/01105—T1) Fast neutron dosimetry. Progress report, July 1, 1979-June 30, 1980. Attix, F.H. (Wisconsin Univ., Madison (USA). Dept. of Radiology). 1980. Contract AS02-76EV01105. 224p. NTIS, PC A10/MF A01.

Progress is reported in: the development and testing of new gas mixtures more suitable for fast neutron dosimetry using the common A150-type Tissue-equivalent plastic ion chambers; comparison of photon doses determined with a graphite-walled proportional counter and with paired dosimeters irradiated by 14.8-MeV neutrons; a detector for the direct measurement of LET distributions from irradiation with fast neutrons; LET distributions from fast neutron irradiation of TE-plastic and graphite measured in a cylindrically symmetric geometry; progress in development of a tandem fast neutron and ^{60}Co gamma ray source irradiation facility; an approach to the correlation of cellular response with lineal energy; calculated and measured HTO atmospheric dispersion rates within meters of a release site; application of cavity theory to fast neutrons; and fast neutron dosimetry by thermally stimulated currents in Al_2O_3. (GHT)

MEDICAL PHYSICS

DOSIMETRY

REFER ALSO TO CITATION(S) 37209

37358 (PNL—3213) Personnel neutron dosimetry at Department of Energy facilities. Brackenbush, L.W.; Endres, G.W.R.; Selby, J.M.; Vallario, E.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 102p. NTIS, PC A06/MF A01.

This study assesses the state of personnel neutron dosimetry at DOE facilities. A survey of the personnel dosimetry systems in use

at major DOE facilities was conducted, a literature search was made to determine recent advances in neutron dosimetry, and several dosimetry experts were interviewed. It was concluded that personnel neutron dosimeters do not meet current needs and that serious problems exist now and will increase in the future if neutron quality factors are increased and/or dose limits are lowered.

SOLID STATE PHYSICS

37359 (LBL—10000, pp 164-205) **Materials sciences: solid state physics.** Mar 1980.

In Materials and Molecular Research Division annual report 1979.

Research using the infrared and near-millimeter wavelength range of the electromagnetic spectrum as a probe is described. Project studies include: infrared spectra of CO chemisorbed on Ni; electrons on the surface of liquid helium; superconducting receivers for millimeter microwaves; and grid polarizers for infrared Fourier spectrometers. (GHT)

37360 Studies in molecular dynamics. XVIII. The square-well phase diagram. Young, D.A.; Alder, B.J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *J. Chem. Phys.;* **73**: No. 5, 2430-2434(1 Sep 1980).

Accurate molecular dynamics calculations have been made for the thermodynamic properties of the square-well potential in the solid phase. Hard-sphere perturbation terms for fcc and hcp phases have been computed over the solid range, and a phase diagram including solid—solid and solid—liquid phase boundaries has been constructed. The discontinuous square-well potential gives rise to an fcc—fcc phase transition which ends in a critical point. Both fcc and hcp phases have regions of stability, but calculations show that bcc is unstable.

37361 Statistical calculation for a model ferromagnetic liquid. Feijoo, L.; Woo, C.; Rajan, V.T. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2404-2410(1 Sep 1980).

A theoretical method is developed for treating model ferromagnetic liquids. In this method the spins are treated in the mean-field approximation while spatial correlations are retained in a manner similar to conventional theories of classical liquids. Coupled self-consistency equations for the magnetization and an effective radial distribution function are derived and solved. The method is applied to a primitive model characterized by a simple spin-dependent interparticle potential. Conditions under which such a simple liquid can exhibit ferromagnetic order are determined. Numerical examples show how the transition temperature and the temperature dependence of the magnetization can be calculated.

37362 Renormalization-group studies of antiferromagnetic chains. II. Long-range interactions. Rabin, J.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., B: Condens. Matter;* **22**: No. 5, 2420-2427(1 Sep 1980).

A real-space, zero-temperature renormalization-group method is used to study a Heisenberg antiferromagnetic spin chain with long-range interactions varying as (distance)/sup -p/. Simple renormalization-group equations are obtained and studied analytically, and the results are checked against a more accurate numerical calculation. The calculations provide evidence for a phase transition at $p \simeq 1.85$ characterized by a change in the behavior of zero-temperature correlation functions. For $p >$ or $\simeq 1.85$ the large-distance physics is that of the nearest-neighbor antiferromagnet, while there is a line of fixed points for $p <$ or $\simeq 1.85$. I conjecture that $p \simeq 1.85$ also marks an order-disorder transition at finite temperature such as occurs in the Ising model with power-law interactions.

37363 Delay-time statistics and inhomogeneous line broadening in superfluorescence. Haake, F.; Haus, J.; King, H.; Schroeder, G.; Glauber, R. (Fachbereich Physik, Gesamthochschule Essen, D-4300 Essen, Germany). EY-76-C-02-3064. *Phys. Rev. Lett.;* **45**: No. 7, 558-561(18 Aug 1980).

A probability distribution W(t) for the delay time t of superfluorescent pulses is defined in terms of a functional integral, which is evaluated exactly. Although the linearized early-stage dynamics is used, full agreement is obtained with previous numerical and experimental results for the variance of t and, more generally, for the shape of W(t). The effect of inhomogeneous broadening of the atomic levels, showing that decrease of the dephasing time T_2^* leads to substantial increase of the mean and variance of t, is also analyzed.

37364 Ground state of the electron gas by a stochastic method. Ceperley, D.M.; Alder, B.J. (National Resource for Computation in Chemistry, Lawrence Berkeley Laboratory, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev. Lett.;* **45**: No. 7, 566-569(18 Aug 1980).

An exact stochastic simulation of the Schroedinger equation for charged bosons and fermions has been used to calculate the correlation energies, to locate the transitions to their respective crystal phases at zero temperature within 10%, and to establish the stability at intermediate densities of ferromagnetic fluid of electrons.

SOLID STATE PLASMA

REFER ALSO TO CITATION(S) 37364

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 36920, 36923, 36941

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

37365 Diagrams for quantum oscillators. Ferrell, T.L. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Am. J. Phys.;* **48**: No. 9, 728-731(Sep 1980).

Diagrams are constructed for matrix elements associated with perturbed harmonic oscillators in quantum mechanics. The diagrams are shown to enable efficient computation of energy shifts and transmission probabilities. An intuitive approach to the diagrammatic technique is used so that introductory quantum courses can incorporate the methods presented.

STATISTICAL PHYSICS AND THERMODYNAMICS

37366 (LBL—11384) **Model for predicting thermal conductivity of rock-fluid systems.** Ghaffari, A. (California Univ., Berkeley (USA). Coll. of Engineering). Aug 1980. Contract W-7405-ENG-48. 143p. NTIS, PC A07/MF A01.

Thesis.

An analytical study is presented for determining the effective thermal conductivity of partially liquid saturated porous media. A model made up of normal cubic-packed spheres, flattened at their contacts is utilized. The relative size of the contacts is determined from the two easily measurable properties of porosity and electrical formation resistivity factor. A reasonable fluid distribution in the model is incorporated by choosing the wetting phase to be a spherical layer of uniform thickness on the solid grain surfaces. Neglecting the contribution of any convection of the fluids in the pore channels and heat transfer by radiation, the heat conduction equation was solved for a unit cell of the model. The final results are presented in the form of working graphs using the dimensionless groupings of effective thermal conductivity divided by fluid or solid conductivity, solid conductivity divided by fluid conductivity, porosity, saturation of the wetting phase and dimensionless radius of top-bottom contacts. There is good agreement between values of the effective thermal conductivities of partially liquid saturated consolidated sandstones and unconsolidated sands calculated by the model and existing experimental data.

ELECTRICITY AND MAGNETISM

37367 Critical binding of an electron by a nonstationary, point-dipole rotor. Garrett, W.R. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **22**: No. 4, 1769-1770(Oct 1980).

The critical binding properties of a nonstationary finite dipole rotor, explored earlier, are shown in the case of the nonphysical but mathematically interesting point-dipole rotor, to collapse back to the familiar properties of the stationary point dipole.

MATHEMATICAL PHYSICS

37368 Three lectures on solitons. Wick, G.C. (Columbia Univ., New York, NY). pp 85-114 of Understanding the fundamental constituents of matter. Zichichi, A. (ed.). New York, NY; Plenum Press (1978).

From E. Majorana school of subnuclear physics; Erice, Italy (8 Aug 1976).

Certain nonlinear two-dimensional wave equations possess soliton solutions, describing solitary waves, that travel without changing shape or size. The Sine-Gordon equation is an example. Particle physicists are interested in solitons, since they constitute stable extended objects that could conceivably serve as interesting

models for certain particles. Soliton solutions of wave equations are discussed from a basically mathematical point of view, including vacuum values, boundary values, sectors, and field theories in 2-, 3-, (or 4-) dimensional space - homotopy groups. The last lecture describes an example of soliton in a pure Yang-Mills theory, the instanton. 5 figures, 1 table. (RWR)

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

37369 (CONF-800932—5) **Electron cyclotron heating on the ISX-B tokamak.** Eldridge, O.C.; England, A.C.; Gilgenbach, R.M.; Hackett, K.F.; Kulchar, A.G.; Loring, C.M.; Wilgen, J.B. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); JAYCOR, Alexandria, VA (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

One experiment on electron cyclotron heating on the Impurity Study Experiment (ISX-b) tokamak has been completed and a second experiment is in progress. In the first experiment, with a gyrotron producing 100 kW at 35 GHz, a heating efficiency greater than 60% was achieved. Unpolarized radiation was launched from the high field side of the tokamak, heating electrons at cyclotron resonance in the center of the plasma. From laser scattering and thermal emission at the second gyroharmonic, the electron temperature, initially 850 eV, increased to 1250 eV at the end of a 15-ms pulse. The second experiment is now in progress, with 180 kW at 28 GHz and a capability of 100-ms pulses. A comparison between polarized and unpolarized radiation, modification of the plasma current profile, and a critical comparison with theory are planned. In this paper, experiments on preionization at the upper hybrid resonance are reported. A plasma with an electron temperature of 10 eV was produced, which is not high enough to reduce impurity radiation. The resistive part of the loop voltage was reduced by preionization. Plans for an experiment to measure electric current induced by electron cyclotron heating are presented, along with a review of the theoretical basis of the current drive.

37370 (DOE/ET/53036—20) **Tokamak current driven by electromagnetic waves.** Mahajan, S.M.; Hitchcock, D.A. (Texas Univ., Austin (USA). Fusion Research Center). Aug 1980. Contract AC05-76ET53036. 10p. (FRCR—215). NTIS, PC A02/MF A01.

An expression for quasilinear diffusion in an electromagnetic field is derived, and based on that, a new scheme for current drive which utilizes the (E x B) motion of electrons in a purely transverse electromagnetic field is proposed and discussed.

37371 (DOE/ET/53051—7) **Ion heating in the ion cyclotron range of frequencies in the Wisconsin Tokapole II.** Biddle, A.P. (Wisconsin Univ., Milwaukee (USA)). Jun 1980. Contract AS02-76ET53051. 190p. NTIS, PC A09/MF A01.

Ion temperatures of 75 eV, a doubling of the ohmic heating temperature in a normal discharge, have been achieved using the fast magnetosonic wave heating at the second, third, and fourth harmonics of the cyclotron frequency in a single component hydrogen plasma. The wave launching structure is a single turn, shielded, insulated loop which constitutes the inductor of the rf source tank circuit. Power levels of 800 kW have been applied to the plasma for periods of up to 1.1 milliseconds. Good agreement has been found between theory and experiment for loading and wave propagation in the plasma for m = 0 and m = +1 modes. Eigenmodes have been observed by peaking of both the rf wave amplitude and the loading of the oscillator, as well as by oscillator frequency shifts imposed by their passage.

37372 (GA-A—15984) **Lower hybrid wave electron heating experiments in Doublet IIA.** Freeman, R.L.; Luxon, J.L.; Chan, V.S. (General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AT03-76ET51011. 26p. (CONF-800932—4). NTIS, PC A03/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Experiments designed to heat electrons by Landau damping of waves at approximately twice the lower hybrid frequency have been carried out on Doublet IIA. This objective is in contrast to other lower hybrid experiments which are designed to heat ions using frequencies corresponding to the lower hybrid resonance frequency. Up to 500 kW of rf power was applied to discharge with approximately 100 kW ohmic input using parallel wavelengths chosen to optimize the spatial distribution of the power deposition based on linear or quasi-linear Landau damping.

37373 (LA—8496-MS) **Application of intense relativistic electron beams to heating and confinement of toroidal plasma experiments.** Ekdahl, C.A. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01.

Because of recently reported successes in the use of intense relativistic electron beams for heating toroidal plasmas, their application in Los Alamos Scientific Laboratory toroidal z-pinch experiments (ZT-40 and ZT-S) is examined. The conclusion is reached that a modestly sized beam (~ k$150) could be useful for heating an experiment with the size of ZT-S, but that it would require a much larger beam to significantly effect the bulk temperature of larger experiments, such as ZT-40.

37374 (PPPL—1701) **Toroidal effects on propagation, damping, and linear mode conversion of lower hybrid waves.** Ignat, D.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 19p. NTIS, PC A02/MF A01.

A common simplifying assumption made in the consideration of radio-frequency heating of tokamaks near the lower hybrid frequency is that the wave-length imposed by the coupling device parallel to the magnetic field is not modified by gradients along the field. In the present calculation, the parallel wave-length is allowed to vary, and important effects are found on wave penetration and damping if the toroidal aspect ratio (R/sub major//r/sub minor/) is less than ~ 5. The calculation shows that heating at the center of a small aspect ratio torus is inhibited by a decrease of k/sub parallel/ if waves are launched at the outside, and that it may be possible to change the plasma current via electron Landau damping with a coupler of symmetric power spectrum by placing the coupler at the top (or bottom) of the torus.

37375 (UCID—18486) **Microwave heating of hot, overdense plasmas.** Eppley, K.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1979. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

Calculations were made of the heating of hot (~ 5 keV), overdense (10^8 critical density) deuterium plasmas by 1 cm microwaves with an incident power of 5 x 10^{16} watts/cm^2. Dependence of the heating rate on the plasma temperature and the drift velocity of the surface was also studied. The power absorption is found to vary approximately as T/sup 1/2/.

37376 (UCID—18725) **Results and analysis of the TMX electron-beam injection experiments.** Poulsen, P.; Grubb, D.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1980. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01.

Electron beams (e-beams) were injected into the Tandem Mirror Experiment (TMX) plasma in order to investigate the effect on the ion cyclotron fluctuations of the plasma. The power level of the e-beams was comparable to that of the injected neutral beams. It was found that injection of the e-beams produced no significant effect on the ion cyclotron fluctuations, the measured plasma parameters, or the particle and power flow of the plasma. The increase in bulk electron temperature and the production of mirror-confined electrons found in previous experiments in which e-beams were injected into a mirror-confined plasma were not observed in this experiment. Analysis of the regions and frequencies of wave creation and absorption within the plasma shows that the plasma density and magnetic field profiles through the plasma strongly affect the resonances encountered by the waves. The steep axial density profiles produced by neutral-beam injection in the TMX experiment are not conducive to efficient coupling of the e-beam energy to the plasma.

37377 (UCID—18784) **Confinement of alpha particles in tandem mirrors.** Devoto, R.S.; Ohnishi, M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 8 Sep 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

Mechanisms leading to loss of alpha particles from non-axisymmetric tandem mirrors are considered. Stochastic diffusion due to bounce-drift resonances can cause rapid radial loss of high energy particles but can be suppressed by imposing a 20% rise in axisymmetric field before the quadrupole transition sections. With this field, radial losses due to resonances should be minimal until alpha particles near thermal energies, when they enter the resonance plateau regime. Retention in the plasma of 60 to 80% of alpha-particle energy appears possible; precise calculation requires computation of drift orbits, of which two typical examples, resonant and non-resonant, are presented.

37378 **Depletion of ripple-trapped particles in the Alcator tokamaks.** Greenwald, M.; Schuss, J.J.; Cope, D. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* **20**: No. 6, 783-785(Jun 1980).

The presence of a toroidal field ripple greater than 2% in the Alcator A tokamak allows for the trapping and rapid ΔB drift loss of ions in the port gap of the toroidal field magnet. The resulting

depletion of high-energy ions is observed by perpendicular charge-exchange measurements and may point to a significant energetic ion loss mechanism in Alcator A. Small ripple, larger minor radius and higher toroidal field lead to greatly reduced losses in Alcator C.

37379 Simulation of high-temperature regimes and confinement scalings. Coppi, B. (Massachusetts Inst. of Tech., Cambridge (USA)); Taroni, A. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). *Comments Plasma Phys. Controlled Fusion;* **5**: No. 5, 195-201(Feb 1980).

A simulation is presented of high temperature regimes and confinement scalings in toroidal devices.

37380 Ambipolar diffusion in the ELMO Bumpy Torus. Guest, G.E. (General Atomic Co., San Diego, CA (USA)). *Comments Plasma Phys. Controlled Fusion;* **5**: No. 5, 179-188(Feb 1980).

A fundamental physical process is identified which seems likely to play a dominant role in ion confinement in the ELMO Bumpy Torus.

37381 Nonneutral plasmas have exceptional confinement properties. O'Neil, T.M. (California Univ., San Diego, La Jolla (USA). Dept. of Physics). *Comments Plasma Phys. Controlled Fusion;* **5**: No. 5, 213-217(Feb 1980).

Recent experiments have achieved impressively long confinement times for nonneutral plasmas. The experiments are discussed briefly and the theoretical reasons for expecting long confinement times are presented.

37382 Feedback control modeling of plasma position and current during intense heating in ISX-B. Charlton, L.A.; Swain, D.W.; Neilson, G.H. (Oak Ridge Natl Lab, Tenn). *IEEE Trans. Plasma Sci.;* **PS-7**: No. 4, 190-196(Dec 1979).

The ISX-B tokamak at ORNL is designed to have 1.8 MW (and eventually 3 MW) of neutral beam power injected to heat the plasma. The results of a numerical simulation of the feedback control system and poloidal coil power supplies necessary to control the resulting noncircular (D-shaped or elliptical) plasma are presented. The resulting feedback control system is shown to be straightforward, although nonlinear voltage-current dependence is assumed in the power supplies. The required power supplied to the poloidal coils in order to contain the plasma under the high heating rates is estimated. 9 refs.

PLASMA DIAGNOSTICS

37383 (DOE/ET/53004—3) **Plasma diagnostic techniques using particle beam probes.** Jennings, W.C. (Rensselaer Polytechnic Inst., Troy, NY (USA). Plasma Dynamics Lab.). Jul 1980. Contract AS02-76ET53004. 56p. (RPDL—80-15). NTIS, PC A04/MF A01.

A brief overview is given of particle beam probing. The fundamental concepts common to all techniques are discussed as well as the design considerations for choosing a particular diagnostic technique. The capabilities of existing and proposed techniques, and the present status of the techniques in major magnetic confinement geometries is also presented. Techniques which involve the injection of a beam of neutral particles into the plasma are then considered. The techniques of beam attenuation, beam scattering, and active charge exchange using a beam of light particles such as hydrogen or helium are first presented. Optical measurements of the Zeeman splitting of the radiation from a neutral lithium beam is then discussed, including a new proposal for significantly improving this technique through the addition of a dye laser. Two techniques involving the injection of heavy neutral particles are then presented, and the section concludes with two proposed techniques for measuring the properties of the alpha particles produced from actual fusion reactions. The diagnostic techniques which are based upon the injection of a beam of charged particles into the plasma are next described. The advantages and limitations of these techniques in comparison with the neutral techniques are discussed, followed by a description of specific techniques.

37384 (DOE/ET/53004—4) **Recent beam probe measurements on EBT, TMX, and RENTOR.** Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, NY (USA). Plasma Dynamics Lab.). Jun 1980. Contract AS02-76ET53004. 48p. (RPDL—80-13). NTIS, PC A03/MF A01.

It is noted that beam probe systems can provide accurate, reliable measurments of plasma space potential and nf(T/sub e/). Over some temperature range, at least, it should be possible to separate n and T/sub e/ by measuring the multiple ionization reaction products. It is also an ideal diagnostic for studying fluctuations since it provides a simultaneous measurement of phi and nf(T/sub e/) from the same point in the plasma and the measurements are continuous in time. Measurements can be made quasi-continuously in space by rapidly sweeping the beam. By using more than one detector it should be possible to make measurements simultaneously at two different observation points in the plasma.

37385 (KMSF-U—945) **Holographic interferometry: a versatile laser fusion diagnostic.** Busch, G.E. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 5p. (CONF-800208—23). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

Subnanosecond holographic interferometry finds numerous applications in the characterization of the KMSF 2 TW fusion driver and in the probing of sub-critical plasma profiles produced by 1.053 μm and 0.527 μm laser radiation.

37386 (LA-UR—80-1906) **Long wavelength scintillators for fiber-optic applications.** Lyons, P.B.; Franks, L.; Lutz, S.; Flournoy, J.; Fullman, E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801103—3). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The use of fiber optics in plasma diagnostics has spurred the development of long wavelength scintillators with fast temporal characteristics. In this paper we describe several new liquid scintillator systems with fluorescent emissions maxima up to 730 nm. Subnanosecond scintillator FWHM response times have been obtained by the operation of liquid scintillators at elevated temperatures. Data on fiber system sensitivity versus fiber length and scintillator emission wavelength will be presented.

37387 (PPPL—1690) **Plasma density measurements using FM-CW millimeter wave radar techniques.** Doane, J.L.; Mazzucato, E.; Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 20p. NTIS, PC A02/MF A01.

Modified FM-CW radar techniques using swept millimeter-wave oscillators are useful for determining when a particular density has been reached in a plasma. Narrowband measurements on the Princeton Large Torus (PLT) demonstrate the suitability of these techniques for controlling high-power auxiliary plasma heating systems. Broadband measurements using these same techniques are proposed, by which the density profile could be determined.

37388 (PPPL—1696) **Neutron flux measurements around PLT.** Zankl, G.; Strachan, J.D.; Lewis, R.; Pettus, W.; Schmotzer, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 25p. NTIS, PC A02/MF A01.

Using Indium activation foils, the toroidal and poloidal neutron emission patterns were determined for PLT plasmas which include ICRF and neutral beam heating. The activities produced the ^{118}In (n,n') /sup 115m/In reaction were determined by counting the 336 keV γ line of the /sup 115m/In decay. This activation cross section falls just below 2.5 MeV so that the influence of scattered neutrons of degraded energies is reduced. From the magnitude of the activity, the absolute calibration of the PLT fusion neutron emission is obtained with $\leqq$ 40% accuracy.

37389 (SAND—80-1827) **Feasibility study of a shadowgraphy plasma diagnostic using a high-speed framing camera.** Palmer, M.A.; Palmer, R.E.; Widman, A. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01.

An Imacon 675 electro-optical camera operating as fast as 6 x 10^8 frames/sec was used to record ten consecutive shadowgrams of transient plasma interactions. The resolution of the camera system at 6 x 10^8 frames/sec is 4 line pairs/mm perpendicular to the time-sweep direction and 2 line pairs/mm parallel to the time-sweep direction. At 5x optical magnification this corresponds to a resolution of 50 μm x 100 μm in the object plane, with a 2 mm x 1 mm field of view. The probe laser is a 100 mW cw argon-ion laser. This probe laser power is marginal in that it is just above the system recording threshold and is only slightly brighter than the plasma emission. A more intense probe laser would improve system performance considerably and may allow this technique to be a useful plasma diagnostic tool.

PLASMA KINETICS - GENERAL

37390 (PPPL—1686) **Stark broadening of isolated lines from high-Z emitters in dense plasmas.** Weisheit, J.C.; Pollock, E.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract AM02-76CH03073. 18p. (CONF-800768—1). NTIS, PC A02/MF A01.

From 5. international conference on spectral line shapes; Berlin, F.R. Germany (7 Jul 1980).

The joint distribution of the electric microfield and its longitudinal derivative is required for the calculation of line profiles for the He-like ions in very dense plasmas. We used a molecular dynamics code to compute exact distributions in single- and multi-component plasmas, and then we investigated various analytical approximations to these results. We found that a simplified, two-nearest-

neighbor scheme leads to surprisingly accurate distribution functions. Our results are illustrated by sample profiles for Ne^{+8} and Ar^{+16} resonance lines.

PLASMA KINETICS - EXPERIMENTAL

37391 (GA-A—15800) **Application of an array processor to the analysis of magnetic data for the Doublet III tokamak.** Wang, T.S.; Saito, M.T. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET51011. 17p. (CONF-800415—3). NTIS, PC A02/MF A01.

From 4. annual FPS Users' conference; San Francisco, CA, USA (28 Apr 1980).

Discussed herein is a fast computational technique employing the Floating Point Systems AP-190L array processor to analyze magnetic data for the Doublet III tokamak, a fusion research device. Interpretation of the experimental data requires the repeated solution of a free-boundary nonlinear partial differential equation, which describes the magnetohydrodynamic (MHD) equilibrium of the plasma. For this particular application, we have found that the array processor is only 1.4 and 3.5 times slower than the CDC-7600 and CRAY computers, respectively. The overhead on the host DEC-10 computer was kept to a minimum by chaining the complete Poisson solver and free-boundary algorithm into one single-load module using the vector function chainer (VFC). A simple time-sharing scheme for using the MHD code is also discussed.

37392 (PPL—1689) **Surface chemistry of stainless steel and evaporated titanium layers in tokamaks.** Staib, P.; Dylla, H.F.; Rossenagel, S.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1980. Contract AM02-76CH03073. 17p. (CONF-800455—19). NTIS, PC A02/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

The combined use of x-ray photoelectron spectroscopy and secondary ion mass spectroscopy is shown to be a powerful tool in the investigation of the chemical modifications of a surface in interaction with a plasma. The reported investigations are performed in-situ in the surface analysis station of the PDX tokamak. The evolution of stainless steel surfaces is followed after various treatments such as hydrogen glow discharge conditioning (GDC), exposure to tokamak discharges, and ion sputtering. Iron oxides are shown to be partially reduced by exposure to GDC; the metal-oxide binding is converted to metal-hydroxide binding from which water can be desorbed. The oxygen behavior on evaporated titanium films is substantially different: the oxide layer evolves to higher oxidation states during exposure to GDC. In contrast, the behavior of carbon is identical on both stainless steel and titanium surfaces: carbon is removed during exposure to GDC via the formation of methane which can spontaneously desorb from the surface.

37393 **Rate of electron heating in a multidipole plasma.** Leung, K.N.; Kribel, R.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Phys. Fluids;* **23**: No. 9, 1923-1925(Sep 1980).

The rate of increase in electron temperature in a multidipole device due to the interaction of a group of test electrons with an argon plasma is determined.

37394 **Runaway-electron-dominated discharges in ORMAK.** Swain, D.W.; Zweben, S.J. (Oak Ridge National Lab., TN (USA)). *Nucl. Fusion;* **20**: No. 6, 711-725(Jun 1980).

Near the end of the ORMAK tokamak operation, a series of experiments was performed in which the bulk of the toroidal current was carried by relativistic runaway electrons. New or improved measurements of RF and microwave emission, electron temperatures, and hard X-ray flux were made. Of particular interest is the observation that the RF signal levels are remarkably low, less than a conventional (non-runaway) discharge. The data are compared with two runaway electron creation models and tend to agree better with a model in which runaways are created continuously throughout the discharge.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 37418

37395 (DOE/ER/03463—53) **Theory of heavy ion collisions. Annual progress report.** Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Physics). Aug 1980. Contract AS02-76ER03463. 27p. NTIS, PC A03/MF A01.

It is demonstrated clearly that macroscopic models account for many of the observed features of heavy ion collisions. During this phase of the program major steps have been taken toward a better understanding of fusion excitation function, strongly damped collisions, the emission of nucleons at intermediate energies, heavy ion collisions and pions in relativistic heavy ion collisions.

37396 (DOE/ET/53041—12) **Computer simulation of kinetic properties of plasmas. Progress report, July 1, 1979-June 30, 1980.** Denavit, J. (Northwestern Univ., Evanston, IL (USA)). 1980. Contract AC02-76ET53041. 9p. NTIS, PC A02/MF A01.

The research is directed toward the development and testing of new numerical methods for particle and hybrid simulation of plasmas, and their application to physical problems of current significance to Magnetic Fusion Energy. During the present period, research on the project has been concerned with the following specific problems: (1) Consideration of radial dependence and shear stabilization of drift and dissipative trapped-electron instabilities. (2) Long-time-scale algorithms for particle simulation with ω/sub pe/Δt much greater than 1. (3) Computer studies of field-reversed ion rings.

37397 (LA—8518-MS) **Radial extent of alpha particle orbits in the reversed field pinch.** Spencer, R.L. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

The radial extent of 3.5 MeV α-particles in a straight cylinder reversed field pinch with Bessel function model field profiles is computed. It is found that an axial current of 1 MA confines all such particles born at a radius less than 0.7 a where a is the wall radius.

37398 (NRL-MR—4348) **Transport studies in reversed field theta pinches.** Manheimer, W.M.; Finn, J.M. (Naval Research Lab., Washington, DC (USA)). 25 Sep 1980. Contract AI01-76ET53020. 32p. NTIS, PC A03/MF A01.

This paper examines anomalous transport in a reversed field theta pinch. The principal effects are anomalous resistivity and rotation generation. Similarity solutions for the resistive decay are found which agree qualitatively with experiment. Also it is shown that the spin up and anomalous resistivity may be the effect of a single underlying cause, a current driven microinstability.

37399 (PPPL—1706) **Two-dimensional modeling of the formation of spheromak configurations.** Jardin, S.C.; Park, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 49p. NTIS, PC A03/MF A01.

A reduced set of two-dimensional MHD equations have been derived describing the axisymmetric time evolution of a MHD stable plasma evolving slowly due to resistive diffusion and changing boundary conditions. The equations are restricted to low β but allow changing topology. They are integrated in time to demonstrate a possible spheromak formation method. External circuit equations are integrated simultaneously with the plasma equations to determine the electromagnetic boundary conditions self consistently. The effects of a finite conductivity vacuum chamber are included.

37400 **Tokamak plasma variations under rapid compression.** Holmes, J.A.; Peng, Y.M.; Lynch, S.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 9, 1874-1879(Sep 1980).

Changes in plasmas undergoing large, rapid compressions are examined numerically over the following range of aspect ratios A: $3>$ or $\approx A>$ or ≈ 1.5 for major radius compressions of circular, elliptical, and D-shaped cross sections; and $3<$ or $\approx A<$ or ≈ 6 for minor radius compressions of circular and D-shaped cross sections. The numerical approach combines the computation of fixed boundary magnetohydrodynamic equilibria with single-fluid, flux-surface-averaged energy balance, particle balance, and magnetic flux diffusion equations. It is found that the dependences of plasma current I/sub p/ and volume-averaged poloidal beta beta-bar/sub p/ on the compression ratio C differ significantly in major radius compressions from those proposed by Furth and Yoshikawa. The present interpretation is that compression to small A dramatically increases the plasma current, which lowers beta-bar/sub p/ and makes the plasma more paramagnetic. Despite large values of volume-averaged toroidal beta beta-bar/sub t/ ($>$ or $\approx 30\%$ with safety factor $q \approx 1$ at the magnetic axis, $q \approx 3$ at the plasma edge), this tends to concentrate more toroidal flux near the magnetic axis, which means that a reduced minor radius is required to preserve the continuity of the toroidal flux function F at the plasma edge. Minor radius compressions to large aspect ratio agree well with the Furth—Yoshikawa scaling laws.

37401 **Guiding-center Hamiltonian for large gyroexcursion particles in mirror configurations.** Mynick, H.E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Phys. Fluids;* **23**: No. 9, 1888-1896(Sep 1980).

An explicit expression is derived for the guiding-center Hamiltonian K, an expression valid for particles having gyroexcursion rho comparable to the system size, such as the high-energy ring particles in the Berta experiment. The form of K is quite simple. It depends on the magnetic field strength B and its radial derivatives, evaluated at an average radius of the particle from the symmetry axis, and it allows for a slow, but otherwise arbitrary, variation of B along the axis. The adiabatic invariant of the gyromotion is related not to the full kinetic energy of the particle normal to the field, as is μequivalent(1/2)mv/sub perpendicular/^{2}/B in small-rho theories,

but rather to the small additional kinetic energy due to the radial wobble of the particle about a constant-radius orbit.

37402 Guiding-center Hamiltonian for figure-8 particles in axisymmetric field-reversed configurations. Mynick, H.E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Phys. Fluids;* **23**: No. 9, 1897-1902(Sep 1980).

The guiding-center Hamiltonian K is derived for so-called "figure-8" particles which are present in field-reversed mirror configurations, using a formalism developed previously. For such particles, the gyro-orbit cannot be approximated by a circle, and thus standard approches to guiding-center theory are totally inapplicable. K manifests this intrinsic difference by a quite different dependence on the gyro-action, and by familiar effects such as mirroring and magnetic-gradient drifts being controlled by the radial derivative of the magnetic field strength B at the point of field reversal, rather than by B itself, as occurs in standard guiding-center theory.

37403 Variational corrections to ELMO Bumpy Torus neoclassical ion plateau transport. Spong, D.A.; Hedrick, C.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 9, 1903-1914(Sep 1980).

Low collisionality corrections to ELMO Bumpy Torus (EBT) ion plateau transport coefficients are calculated using a variational method. Using a bounce-averaged drift kinetic equation and a drift orbit model appropriate to collisionless EBT ion transport, a solution is obtained that is accurate to first order in $\epsilon(\Omega_0/\nu_0)$/sup 2/ 3/ (ϵ is the inverse aspect ratio, ν_0 is the 90° deflection frequency, and Ω_0 is the average poloidal gradient B drift frequency). This is substituted into a variational principle (valid over both the plateau and banana regimes) from which particle and energy fluxes are obtained. The sensitivity of the transport rates with respect to variations in the radial and poloidal components of the ambipolar electric field and with respect to variations in the poloidal drift frequency scale length is examined. The transition from plateau to crescent orbit scaling occurs at approximately $\nu_0/\Omega_0=\epsilon$/sup 3/2/.

37404 Simplified eigenvalue equation for ideal magnetohydrodynamics. Kadish, A. (Science Applications, Inc., 1710 Goodridge Drive, McLean, Virginia 22102). *Phys. Fluids;* **23**: No. 9, 1920-1921(Sep 1980).

A change of dependent variable renders the eigenfunction equation of ideal magnetohydrodynamics more amenable to analysis of the discrete spectrum. The resulting equation and boundary value problem are discussed.

37405 Self-consistent model of stochastic magnetic fields. Diamond, P.H.; Dupree, T.H.; Tetreault, D.J. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **45**: No. 7, 562-565(18 Aug 1980).

In this Letter, a model is described in which spatially stochastic magnetic field and current fluctuations in a plasma with sheared average magnetic field are treated consistently with Ampere's Law.

37406 Toroidal MHD equilibrium of the Elmo Bumpy Torus. Freidberg, J.P. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* **20**: No. 6, 673-682(Jun 1980).

Analytic toroidal equilibria of the Elmo Bumpy Torus configuration are calculated by means of an asymptotic expansion in the amplitude of the bumpiness. Equilibria containing a magnetic well are found where β is smaller than that in a high-β stellarator but comparable to or higher than that in a high-β tokamak or conventional stellarator. It is shown that the plasma shifts inward in a torus and that the magnetic well exists even if the mirror ratio is small and the aspect ratio is infinite.

37407 Theta-pinch (Thor) numerical simulation - a hybrid model with self-consistent anomalous transport. Busnardo Neto, J. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica); Liewer, P. (University of Maryland); Sgro, A.G. (Los Alamos Scientific Lab., NM (USA)). *Cienc. Cult. (Sao Paulo) Supl.;* **31**: No. 7, 288(Jul 1979). (In Portuguese).

From 31. Annual Meeting of the Brazilian Society for the Advancement of Science; Fortaleza, Brazil (11 - 18 Jul 1979).

37408 Transport in toroidal stellarators and torsatrons. Shohet, J.L. Contract ET-78-S-02-5069. *Comments Plasma Phys.;* **5**: No. 2, 55-67(1979).

The behavior of stellarator/torsatron configurations in the collisionless regime is important to their viability as a fusion reactor. A summary of various predictions of the behavior of the diffusion coefficient in this regime is given, together with a comparison with expected results.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 37396, 37421

37409 (COO—2387-113) Stability analysis of cylindrical Vlasov equilibria. Short, R.W. (Wisconsin Univ., Madison (USA)). 1979. Contract AS02-76ET53051. 214p. NTIS, PC A10/MF A01.

Thesis.

A general method of stability analysis is described which may be applied to a large class of such problems, namely those which are described dynamically by the Vlasov equation, and geometrically by cylindrical symmetry. The method is presented for the simple case of the Vlasov-Poisson (electrostatic) equations, and the results are applied to a calculation of the lower-hybrid-drift instability in a plasma with a rigid rotor distribution function. The method is extended to the full Vlasov-Maxwell (electromagnetic) equations. These results are applied to a calculation of the instability of the extraordinary electromagnetic mode in a relativistic E-layer interacting with a background plasma.

37410 General theory of kinetic ballooning modes. Frieman, E.A.; Rewoldt, G.; Tang, W.M.; Glasser, A.H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Phys. Fluids;* **23**: No. 9, 1750-1769(Sep 1980).

The "ballooning mode formalism," previously developed for the ideal magnetohydrodynamic problem, is applied to the kinetic problem in tokamaks. The general two-dimensional equation governing drift and trapped-electron eigenmodes reduces to a one-dimensional integral equation along the lines of force with the radial structure determined by a WKB procedure. Comparisons made between the present one-dimensional code and a previous two-dimensional code embodying identical physical assumptions indicate reasonable agreement. This correspondence holds both for the structure along the field line and for the radial structure in the special case of closely spaced turning points.

37411 Unstable universal drift eigenmodes in toroidal plasmas. Cheng, C.Z.; Chen, L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Phys. Fluids;* **23**: No. 9, 1770-1773(Sep 1980).

The eigenmode equation describing ballooning collisionless drift instabilities is analyzed both analytically and numerically. A new branch of eigenmodes, which corresponds to quasi-bound states due to toroidal coupling effects such as ion delB drifts, is shown to be destabilized by electron Landau damping for typical tokamak parameters. This branch cannot be understood by the strong coupling approximation. However, the slab-like (Pearlstein—Berk-type) branch is found to remain stable and experience enhanced shear damping.

37412 Nonlinear coupling of tearing modes with self-consistent resistivity evolution in tokamaks. Carreras, B.; Hicks, H.R.; Holmes, J.A.; Waddell, B.V. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 9, 1811-1826(Sep 1980).

The nonlinear interaction of tearing modes of different helicity in tokamaks is studied for realistic values of resistivity and parallel heat conduction. The self-consistent evolution of the resistivity is taken into account through the electron heat conduction equation. For equilibrium q profiles inferred from electron temperature profiles measured before a tokamak disruption, the essential result is that the (m=2;n=1) mode nonlinearly destabilizes other modes on a rapid time scale. Because of the development of magnetic islands of different helicity, the toroidal current density is severely deformed. These islands overlap and field lines become stochastic in a sizable plasma volume, flattening the temperature profile in this region through parallel heat transport. The deformation of the toroidal current produces a rapid decrease in the self-inductance of the plasma, and the voltage at the limiter decreases, becoming increasingly negative. An extensive survey of equilibria and initial conditions has been conducted and a simple prescription for their nonlinear stability properties is given.

37413 Transient amplification of shear Alfven waves and concomitant development of the gravitational instability. Lau, Y.Y.; Davidson, R.C.; Hui, B. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Fluids;* **23**: No. 9, 1827-1831(Sep 1980).

Making use of the ideal magnetohydrodynamic description in a plasma slab model, the transient amplification of shear Alfven waves and their concomitant development into gravitational (ballooning) instabilities as the plasma pressure is increased are studied. When applied to tokamak geometry, for $\beta<\beta$/sub c//2, it is found that the curvature effect has a negligibly small influence on the evolution of the shear Alfven waves. (Here, β is the ratio of plasma pressure to magnetic pressure, β/sub c/ =Rr/sub n//L/sub s/^{2} is the critical beta, R is the major radius, r/sub n/ is the plasma density length scale, and L/sub s/ is the magnetic shear length scale.) The curvature effect becomes dominant, however, for $\beta>$ or $\approx(3/4)\beta$/sub c/, and the instability exhibits very strong growth whenever $\beta>$ or $\approx 1.1\beta$/sub c/.

37414 Rotational instability in a linear theta pinch. Ekdahl, C.; Bartsch, R.R.; Commisso, R.J.; Gribble, R.F.; McKenna, K.F.; Miller, G.; Siemon, R.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **23**: No. 9, 1832-1842(Sep 1980).

The m=1 "wobble" instability of the plasma column in a 5-m linear theta pinch has been studied using an axial array of orthogonally viewing position detectors to resolve the wavelength and frequency of the column motion. The experimental results are compared with recent theoretical predictions that include finite Larmor orbit effects. The frequency and wavelength characteristics at saturation agree with the predicted dispersion relation for a plasma rotating faster than the diamagnetic drift speed. Measurements of the magnetic fields at the ends of the pinch establish the existence of currents flowing in such a way that they short out the radial electric fields in the plasma column. The magnitude of rotation, the observed delay in the onset of m=1 motion, and the magnitude of end-shorting currents can all be understood in terms of the torsional Alfven waves that communicate to the central plasma column the information that the ends have been shorted. The same waves are responsible for the torque which rotates the plasma and leads to the observed m=1 instability. Observations of the plasma in the presence of solid end plugs indicate a stabilization of high-m number modes and a reduction of the m=1 amplitude.

37415 Effects of hot electrons on magnetohydrodynamic modes in ELMO Bumpy Torus. Nelson, D.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 9, 1850-1856(Sep 1980).

The effect of hot electrons on magnetohydrodynamic instabilities is studied using a fully electromagnetic, finite β, Vlasov—Maxwell model consisting of three species in an inhomogeneous slab geometry with gravity. If no hot electrons are present, the Vlasov model agrees with well-known results from the magneto-hydrodynamic model. If the density of hot electrons is small, but their temperature is sufficiently large, the Vlasov model predicts stabilization of magnetohydrodynamic modes in certain parameter regimes. For ELMO Bumpy Torus parameters this occurs at β=10%—20%, which is in agreement with experimental observations. Comparison is also made with a model that assumes the hot electrons form a rigid non-interacting current. It is found that while the latter model can qualitatively predict the low β stability threshold, it is overly optimistic in describing the finite β behavior.

37416 (UCRL-Trans—11614) **MHD plasma stability in high mirror ratio open traps.** Ryutov, D.D.; Stupakov, G.V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 29 Jul 1980. Translation of Russian Journal Preprint 8--130. 25p. NTIS, PC A02/MF A01.

On the basis of graphic considerations, Section 2 estimates the perturbation of plasma magnetic energy and finds the conditions under which a high mirror ratio actually leads to a decrease in β/sub crit/. With allowance for these results, Section 3 makes a formal minimization of the system's total potential energy and finds the equation for the eigenfunctions of the most dangerous perturbations. This equation is solved in Section 4, where, as a result, simple analytic formulas are derived for β/sub crit/.

37417 Axisymmetric instability in a non-circular tokamak: experiment and theory. Lipschultz, B.; Prager, S.C. (Wisconsin Univ., Madison (USA)); Todd, A.M.M.; Delucia, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **20**: No. 6, 683-694(Jun 1980).

The stability of dee, inverse-dee and square-cross-section plasmas to axisymmetric modes has been investigated experimentally in Tokapole II, a tokamak with a four-null poloidal divertor. Experimental results are closely compared with predictions of two numerical stability codes: the PEST code (ideal MHD, linear stability) adapted to tokapole geometry and a code which follows the nonlinear evolution of shapes similar to tokapole equilibria. Experimentally, there exists an optimal initial vertical position for the plasma for which both dees will experience a small oscillation with the restoring force provided by non-linear passive feedback. Slight vertical displacement of the initial position causes, however, both dees to be unstable to a non-rigid vertical motion. The central-magnetic-axis displacement grows exponentially with a growth time approximately 10^4 poloidal Alfven times or on the order of the plasma L/R time. Contrarily, the square is always vertically stable. Experimental poloidal flux plots are produced directly from internal-magnetic-probe measurements. The PEST code, ignoring passive feedback, predicts all equilibria to be vertically unstable with the square having the slowest growth. With passive feedback, all are stable. Thus experiment and code agree that the square is the most stable shape, but experiment indicates that passive feedback is partially defeated by finite resistivity. In both code and experiment, square-like equilibria exhibit a relatively harmless horizontal instability.

37418 Thermonuclear instabilities and fueling in a tokamak reactor. Bhadra, D.K. (Gen At Co, San Diego, Calif). *IEEE Trans. Plasma Sci.;* **PS-8**: No. 1, 2-9(Mar 1980).

A possible mechanism of supplying fresh fuel from a cold-plasma layer at the surface of the plasma is considered. The existence of an energetic component of ions, viz, the alpha particles, may excite unstable collective oscillations of the plasma (called the thermonuclear instabilities). Such instabilities could give rise to microscopic processes which, in principle, would allow influx of fresh fuel while helping efflux of reaction products. A three-regime model is used to understand the nature of such fueling mechanisms and the possibility of using a cold-plasma layer as a surface fueling source. 14 refs.

37419 Numerical computation of the preionization phase of a toroidal pinch discharge. Lindemuth, I.R.; Pettibone, J.S.; Stevens, J.C.; Kraybill, D.M.; Suter, J.L.; Harding, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Plasma Phys.;* **22**: No. 3, 207-225(Mar 1980).

The general dispersion relation for drift waves in a medium β plasma is derived when gradients of guiding centre drift across the magnetic field are present. It is shown that for high frequency waves cross field shear in the relative velocity of ions and electrons can generate strong electrostatic and electromagnetic instabilities. Turbulence-induced anomalous viscosity is briefly discussed.

37420 Universal mode revisited. Kaw, P.K.; Guzdar, P.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Comments Plasma Phys. Controlled Fusion;* **5**: No. 5, 189-194(Feb 1980).

The theory of universal eigenmodes in a collisionless plasma slab with magnetic shear is reviewed and critically examined.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 37405, 37413

37421 (COO—3497-40) **Annual progress report.** Simon, A. (Rochester Univ., NY (USA). Dept. of Mechanical and Aerospace Sciences). 31 Aug 1980. Contract AS02-76ET53032. 18p. NTIS, PC A02/MF A01.

Research efforts were concentrated on two main topics. One was to obtain a fit between single-mode nonlinear saturation theory and experimental observations on the PR-6 mirror device. A model of this experiment yields good agreement between predictions of the time variation of the fluctuating potential level, the floating potential, the mode wavelength and mode frequency, and observations. The second topic concerned single-mode Landau damping. The previous results of O-Neil-Morales were confirmed, but in much simpler form with no multiple sums. No longer-time corrections of any significant size were uncovered.

37422 Budden tunnelling in parallel stratified plasmas. Batchelor, D.B. (Oak Ridge National Lab., TN (USA)). *Plasma Phys.;* **22**: No. 1, 41-55(Jan 1980).

The process of Budden tunnelling of obliquely propagating extraordinary mode is investigated in plasmas whose parameters vary along the magnetic field (parallel stratification). The wave tunnels through the evanescent region separating the right-hand cutoff layer from the electron cyclotron resonance. Coupled mode equations describing both ordinary and extraordinary waves are derived for arbitrary angle of incidence with respect to the magnetic field. Under appropriate conditions (nsub(x) and d ln(B)/dx not too large) the coupling can be ignored, and the usual Whittaker equation is obtained for a linear magnetic field profile. It is shown that deviation from strictly parallel propagation (nsub(x) is not equal to 0) has a very small effect on tunnelling for a wide range of angle of incidence. The analytical results are verified by numerical integration of the field equations. The theory is applied to the propagation of extraordinary mode waves in the surface plasma of the ELMO Bumpy Torus devices. Fractions of incident power absorbed and transmitted to the high field region in the range of 2-15% occur for a broad spectrum of nsub(x).

37423 Scattering of high frequency waves due to density fluctuations. Hsu, J.Y.; Chiu, S.C.; Chan, V.S. (General Atomic Company, San Diego, California 92138). EY-76-C-03-0167, PROS. AGREEMENT NO. 38. *Phys. Fluids;* **23**: No. 9, 1807-1810 PFL10001(Sep 1980).

A theory of the scattering of high frequency waves by density fluctuations is formulated. In the plasma interior, the usual wave kinetic equation is used to derive a Fokker—Planck equation with the background fluctuations assumed to be given. The possible excitation of electrostatic drift waves by the high frequency waves is also considered and a quasi-linear equation is demonstrated. Stochastic changes in the wave frequency and the group velocity result in the corresponding diffusion and friction in phase space.

37424 Propagation of very slow lower hybrid waves in the Octopole Tokamak. La Haye, R.J.; Armentrout, C.J.; Petersen, P.I.;

Stambaugh, R.D. (General Atomic Company, San Diego, California 92138). *Phys. Fluids;* **23**: No. 9, 1862-1867(Sep 1980).

A multi-element slow wave structure has been used to couple radio-frequency (rf) power to very slow lower hybrid waves in the Octopole-Tokamak plasma. Probing of the distribution of wave power in the plasma revealed strong amplitude modulation and scattering of the wave; however, direct evidence for the propagation of slow waves was obtained by measuring the toroidal wave speed.

37425 Time behavior of nonlinear plasma oscillations. Dewandre, T.; Simon, A. (Department of Mechanical and Aerospace Sciences, University of Rochester, Rochester, New York 14627). EY-76-S-02-3497. *Phys. Fluids;* **23**: No. 9, 1922-1923(Sep 1980).

The time behavior of a single weakly damped electron mode is analyzed. Analytic expressions for the time-dependent mode damping and frequency shift equivalent to those of O'Neil and to those of Morales and O'Neil are obtained, but in a much simpler form since there are no sums.

37426 Study of low-frequency microturbulence in the Microtor tokamak by far-infrared laser scattering. Semet, A.; Mase, A.; Peebles, W.A.; Luhmann, N.C. Jr.; Zweben, S. (University of California, Los Angeles, California 90024). EY-76-C-03-0010,PA26. *Phys. Rev. Lett.;* **45**: No. 6, 445-448(11 Aug 1980).

The first far-infrared laser scattering measurements from a tokamak plasma are reported. Spatially and temporally resolved power spectra of density fluctuations in the Microtor plasma have been studied with an absolutely calibrated far-infrared scattering system which allowed measurement of the wide range of wave numbers from k=3 to 50 cm^{-1}. The wave-number dependence of the scattered power of 0.6< or ≈k/sub perpendicular/rho/sub i/< or ≈2 was found to satisfy a k/sup -3.5/ form.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 36644, 37379

37427 (CONF-800950—7) **Design of a fusion engineering test facility.** Sager, P.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

The fusion Engineering Test Facility (ETF) is being designed to provide for engineering testing capability in a program leading to the demonstration of fusion as a viable energy option. It will combine power-reactor-type components and subsystems into an integrated tokamak system and provide a test bed to test blanket modules in a fusion environment. Because of the uncertainties in impurity control two basic designs are being developed: a design with a bundle divertor (Design 1) and one with a poloidal divertor (Design 2). The two designs are similar where possible, the latter having somewhat larger toroidal field (TF) coils to accommodate removal of the larger torus sectors required for the single-null poloidal divertor. Both designs have a major radius of 5.4 m, a minor radius of 1.3 m, and a D-shaped plasma with an elongation of 1.6. Ten TF coils are incorporated in both designs, producing a toroidal field of 5.5 T on-axis. The ohmic heating and equilibrium field (EF) coils supply sufficient volt-seconds to produce a flat-top burn of 100 s and a duty cycle of 135 s, including a start of 12 s, a burn termination of 10 s, and a pumpdown of 13 s. The total fusion power during burn is 750 MW, giving a neutron wall loading of 1.5 MW/m^2. In Design 1 of the poloidal field (PF) coils except the fast-response EF coils are located outside the FT coils and are superconducting. The fast-response coils are located inside the TF coil bore near the torus and are normal conducting so that they can be easily replaced.In Design 2 all of the PF coils are located outside the TF coils and are superconducting. Ignition is achieved with 60 MW of neutral beam injection at 150 keV. Five megawatts of radio frequency heating (electron cyclotron resonance heating) is used to assist in the startup and limit the breakdown requirement to 25 V.

37428 (IAEA-CN—38/V-1) **Scope and status of the USA Engineering Test Facility including relevant TFTR research and development.** Becraft, W.R.; Reardon, P.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. (CONF-800707—20). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

The vehicle by which the fusion program would move into the engineering testing phase of fusion power development is designated the Engineering Test Facility (ETF). The progress toward the design and construction of the ETF will reflect the significant achievements of past, present, and future experimental tokamak devices. Some of the features of this foundation of experimental results and relevant engineering designs and operation will derive from the Tokamak Fusion Test Reactor (TFTR) Project, now nearing the completion of its construction phase. The ETF would provide a test-bed for reactor components in the fusion environment. In order to initiate preliminary planning for the ETF decision, the Office of Fusion Energy (OFE) established the ETF Design Center activity to prepare the design of the ETF. This paper describes the design status of the ETF and discusses some highlights of the TFTR R and D work.

37429 Engineering problems of fusion research. Report of the 8th Symposium held at San Francisco, California, 13-16 November 1979. Derby, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.); Murray, J.G. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Sager, P.H. (General Atomic Co., San Diego, CA (USA)); Smith, G.E. (Grumman Aerospace Corp., Bethpage, NY (USA)). *Nucl. Fusion;* **20**: No. 6, 787-790(Jun 1980).

This paper presents briefly highlights of the Eighth Symposium held at San Francisco, 13-16 November 1979, on Engineering Problems of Fusion Research.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 36941, 37280

37430 (UCRL—84108) **Background field coils for the High Field Test Facility.** Zbasnik, J.P.; Cornish, D.N.; Scanlan, R.M.; Jewell, A.M.; Leber, R.L.; Rosdahl, A.R.; Chaplin, M.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Sep 1980. Contract W-7405-ENG-48. 5p. (CONF-800980—2). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The High Field Test Facility (HFTF), presently under construction at LLNL, is a set of superconducting coils that will be used to test 1-m-o.d. coils of prototype conductors for fusion magnets in fields up to 12 T. The facility consists of two concentric sets of coils; the outer set is a stack of Nb-Ti solenoids, and the inner set is a pair of solenoids made of cryogenically-stabilized, multifilamentary Nb_3Sn superconductor, developed for use in mirror-fusion magnets. The HFTF system is designed to be parted along the midplane to allow high-field conductors, under development for Tokamak fusion machines, to be inserted and tested. The background field coils were wound pancake-fashion, with cold-welded joints at both the inner and outer diameters. Turn-to-turn insulation was fabricated at LLNL from epoxy-fiberglass strip. The coils were assembled and tested in our 2-m-diam cryostat to verify their operation.

37431 (UCRL—845548) **Mechanical behavior of the mirror fusion test Facility superconducting magnet coils.** Horvath, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 12p. (CONF-800102—15). NTIS, PC A02/MF A01.

From International conference on geotechnical and environmental aspects of geopressure energy; Sea Island, GA, USA (13 Jan 1980).

The mechanical response to winding and electromagnetic loads of the Mirror Fusion Test Facility (MFTF) superconducting coil pack is presented. The 375-ton (3300 N) MFTF Yin-Yang magnet, presently the world's largest superconducting magnet, is scheduled for acceptance cold-testing in May of 1981. The assembly is made up of two identical coils which together contain over 15 miles (24 km) of superconductor wound in 58 consecutive layers of 24 turns each. Topics associated with mechanical behavior include physical properties of the coil pack and its components, winding preload effects, finite element analysis, magnetic load redistribution, and the design impact of predicted conductor motion.

37432 Generalization of Connor and Hastie's ripple-trapping coefficient, G(α). Goldston, R.J.; Towner, H.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **20**: No. 6, 781-783(Jun 1980).

In their calculation of transport due to ripple trapping, Connor and Hastie employ a factor G(α) to take into account the poloidal variation of the depth and shape of the local magnetic wells. They assume, however, that the toroidal-field ripple strength, delta, is independent of the poloidal angle. This letter generalizes G to treat any arbitrary poloidal variation of delta, and also high-beta, non-circular plasma configurations of arbitrary aspect ratio.

37433 Alfven scaling of magnetic pulse penetration in a theta pinch. Tsui, K.H.; Oakes, M.E. (Univ of Tex, Austin). *IEEE Trans. Plasma Sci.;* **PS-7**: No. 4, 229-230(Dec 1979).

Results of a code describing magnetic-field penetration into a plasma with theta-pinch geometry is presented. Classical collisional effects can describe the Alfven velocity scaling but fail to account for observed penetration times and neutral density scaling. 7 refs.

37434 Electrical engineering problems of the tokamak fusion test reactor. Karady, G.; Neumeyer, C.; Cassel, R.; Murray, J. (Princeton

Univ, NJ). pp vp of Joint power generation conference. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From Joint power generation conference; Charlotte, NC, USA (7 Oct 1979).

The Tokamak Fusion Test Reactor has several large coils designated for plasma initiation, confinement, heating, and position control. The coils are supplied by high current pulses with an approximate duration of 10 sec and a repetition period of 5 minutes. The peak power of the pulses is approximately 900 MW with an average power of 30 MW. This paper describes the engineering problems related to the experimental reactor and discusses the flywheel generator energy storage system, the developed rectifier/inverter arrangement, and an operational method which minimizes the reactive power consumption and insures the safe dissipation of magnetic energy in case of a fault. In addition, the switching problem related to the required swing of large current in the ohmic heating coils is analyzed. 7 refs.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 37434, 37444

37435 (UCRL—84042) **Driving parallel flashlamps with a compensated pulsed alternator.** Carder, B.M.; Merritt, B.T.; Gagnon, W.L.; Bird, W.L.; Weldon, W.F.; Zowarka, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Texas Univ., Austin (USA). Center for Electromechanics). 30 May 1980. Contract W-7405-48. 20p. (CONF-800640—18). NTIS, PC A02/MF A01.

From 14. pulse power modulator symposium; Orlando, FL, USA (3 Jun 1980).

Test results are given for a prototype Compensated Pulsed Alternator that was operated up to its 5400 rpm design speed. The machine has delivered approximately 140 kilojoules of energy in a single 1.3 millisecond pulse into a load comprising sixteen parallel flashlamps. The energy delivered to the lamps follows a $W = (rpm/225)^4$ scaling law to about 4200 rpm. Beyond that speed, eddy current losses become significant with the present design. New codes are able to model the machine parameters, and the prototype is presently being rebuilt to reduce the high speed losses predicted by the codes and verified by experiment.

COOLING SYSTEMS

37436 (UCRL—50058-80-2) **Advances in materials science, Metals and Ceramics Division. Triannual progress report, February-May 1980.** Truhan, J.J.; Gordon, K.M. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1980. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01.

Research is reported in the magnetic fusion energy and laser fusion energy programs, aluminium-air battery and vehicle research, geothermal research, nuclear waste management, basic energy science, and chemistry and materials science. (FS)

HEATING AND FUELING SYSTEMS

37437 **D-D neutron measurements on a 40 kV, 60 A neutral beam test facility.** Kim, J.; Mihalczo, J.T. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.). *Nucl. Instrum. Methods;* **169**: No. 1, 83-88(Feb 1980).

Neutron production rates from deuterium-deuterium (D-D) reactions are measured during deuterium beam operation on a prototype neutral beam line developed for fusion research. The neutron detection system consists of a ^{235}U fission chamber, a ^{3}He proportional counter, and thermoluminescent dosimeters (TLDs). Measured neutron yields were lower by a factor of 4 than theoretical values for steady-state, drive-in targets. Measured neutron intensities per unit ampere of beam current at 40 keV ranged between 4×10^{8} and $7 \times 10^{8} s^{-1}$. Variation in neutron intensity is investigated as a function of beam energy (25-40 keV), beam current (30-60 A), and beam pulse length (100-200 ms).

37438 (UCRL—84826) **Hybrid reactors.** Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 9 Sep 1980. Contract W-740ENG-48. 13p. (CONF-800950—6). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

The rationale for hybrid fusion-fission reactors is the production of fissile fuel for fission reactors. A new class of reactor, the fission-suppressed hybrid promises unusually good safety features as well as the ability to support 25 light-water reactors of the same nuclear power rating, or even more high-conversion-ratio reactors such as the heavy-water type. One 4000-MW nuclear hybrid can produce 7200 kg of ^{233}U per year. To obtain good economics, injector efficiency times plasma gain (eta/sub i/Q) should be greater than 2, the wall load should be greater than 1 $MW.m^{-2}$, and the hybrid should cost less than 6 times the cost of a light-water reactor. Introduction rates for the fission-suppressed hybrid are usually rapid.

37439 **Ignition and thermal stability characteristics of advanced-fuel tokamak plasmas with empirical scaling.** Schultz, J.H.; Bromberg, L.; Cohn, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). *Nucl. Fusion;* **20**: No. 6, 703-709(Jun 1980).

Ignition criteria and fusion power density are calculated for catalysed-D and D-^{3}He plasmas for hot-ion-mode (Tsub(i)>Tsub(e)) operation facilitated by a large ratio of the ion energy confinement time to the electron energy cofinement time. The optimistic case of complete transfer of the energy of the charged-particle fusion products to the ions is considered; this case further enhances hot-ion-mode operation. Even though hot-ion-mode operation increases the fusion power density, the maximum pressure-limited fusion power densities in catalysed-D and D-^{3}He are at least a factor of thirty times lower than those in D-T plasmas; as a result the achievement of very high plasmas beta and/or the maximum use of high-field magnet technology are needed in order to attain high wall loadings and moderate thermal output power levels in D-D and D-^{3}He reactors. The implications of ignition requirements on machine design are determined for tokamak plasmas; the electron energy confinement time is assumed to be given by an empirical energy scaling law, tausub(e) approximately na^{2}. The thermal stability of advanced fuel plasmas is studied. It is found that the runaway time is short compared to the energy confinement time for ion temperatures that maximize the fusion power of a pressure-limited plasma.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 37447

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 37065, 37066, 37385, 37435

37440 (KMSF-U—936) **Implosion experiments with low intensity, nanosecond laser pulses.** Slater, D.C.; Grandey, R.A.; Johnson, R.R.; Mayer, F.J.; Charatis, G.; Busch, G.; Bennish, A.H. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 4p. (CONF-800208—22). NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

Spherical target implosion experiments using ~ 1 nanosecond laser pulses of 2×10^{13} to 5×10^{14} W/cm^{2} irradiance show some differences from short pulse, high intensity experiments. One dimensional hydrocode simulations were compared with the data.

37441 (LA-UR—80-1922) **CO_2 laser capital costs and efficiencies for ICF commercial applications.** Pendergrass, J.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-801107—14). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The magnitude of the differences in capital cost for single ring and multiring geometry is indicated. The dependence of capital cost on pulse repetition rate is shown. Data gives values of capital costs and overall efficiencies for CO_2 lasers with repetition rates of 2 to 40 Hz^{3} and output energies of 1 to 10 MJ with salt and aerowindows. (MOW)

37442 (LBL—11120) **Multi-megajoule heavy ion induction linacs.** Faltens, A.; Hoyer, E.; Keefe, D.; Laslett, L.J.; Smith, L.; Bangerter, R.O.; Herrmannsfeldt, W.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 12p. (CONF-800707—21). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

One of the most promising Inertial Confinement Fusion (ICF) igniter concepts is the heavy ion induction linac system. A driver providing a beam of heavy ions has the potential advantages of a short ion range in the target material, a very large power transport capability, and the ability to produce high power densities at distances of 5 to 10 meters from the final lens elements required in a power producing reactor. Many driver configurations are possible, and it has been generally found that the driver would be the dominant cost item in a power plant. Some preliminary results obtained from a design and cost optimization computer program for an ion induction linac accelerator are presented. An estimate of the effect of ICF system cost on the cost of generated electricity is made.

37443 (RL—79-092) **Report on impact fusion workshop, LASL, July 1979.** Russell, F.M. (Science Research Council, Chilton (UK). Rutherford and Appleton Labs.). Dec 1979. 13p. NTIS (US Sales Only), PC A02/MF A01.

The concept of power production from thermonuclear fusion caused by inertial confinement of D,T fuel was examined from the standpoints of overall scientific feasibility and present state-of-art in the technologies involved. No defect in principle was found but

much R and D work is needed in all aspects and especially that of accelerator devices. So far only one intrinsically stable macroparticle accelerator has been proposed, based on the mixed-μ concept of stability.

37444 (UCRL—82937) **High density energy storage capacitor.** Whitham, K.; Howland, M.M.; Hutzler, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—174). NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The Nova laser system will use 130 MJ of capacitive energy storage and have a peak power capability of 250,000 MW. This capacitor bank is a significant portion of the laser cost and requires a large portion of the physical facilities. In order to reduce the cost and volume required by the bank, the Laser Fusion Program funded contracts with three energy storage capacitor producers: Aerovox, G.E., and Maxwell Laboratories, to develop higher energy density, lower cost energy storage capacitors. This paper describes the designs which resulted from the Aerovox development contract, and specifically addresses the design and initial life testing of a 12.5 kJ, 22 kV capacitor with a density of 4.2 J/in^3 and a projected cost in the range of 5 cents per joule.

37445 (SLAC-Trans—0193) **Focusing of intense heavy-ion beams onto a thermonuclear target.** Vorob'yeva, E.Ya.; Zenkevich, P.R.; Koshkarev, D.G. (Stanford Linear Accelerator Center, CA (USA)). Aug 1980. Translation of ITEF—31, pp 1-11, 1980. 12p. NTIS, PC A02/MF A01.

The goal of the present paper is to analyze the influence of nonuniformity of beam longitudinal density on transverse focusing. The following assumptions were made in solving the problem: (1) the plasma density in the reactor chamber is negligibly small; and (2) the transverse motion is described by the Kapchinskii-Vladimirskii equation for the beam envelope.

37446 **Magnetic-gun igniter for controlled thermonuclear fusion.** Garwin, R.L. (IBM Watson Research Center, Yorktown Heights, NY (USA)); Muller, R.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Richter, B. (Stanford Linear Accelerator Center, CA (USA)). *Atomkernenerg./Kerntech.;* **35**: No. 4, 300-301(1980).

A traveling wave linear accelerator of some few km length could accelerate 0.1 g ferromagnetic or superconducting darts to a velocity of about 200 km/sec with an energy density of 20 MJ/g. Such a system might be a near-term low-cost driver for an inertial fusion reactor.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

37447 (BNL—28270) **Performance of BNL-TSTA compound cryopump.** Hseuh, H.C.; Worwetz, H.A. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 20p. (CONF-801037—6). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

A compound cryopump using cryocondensation pumping for hydrogen isotopes and cryosorption pumping with coconut charcoal as adsorbent for helium was designed. This compound cryopump was subsequently built (by Janis Research, Stoneham, MA) and has been tested at Brookhaven, fulfilling the design requirements and are delivered to Tritium Systems Test Assembly (TSTA) Vacuum Facility at Los Alamos Scientific Laboratory (LASL) for on-line operations.

37448 (CONF-801107—22) **Approach to testing fusion components in existing nuclear facilities.** Hsu, P.Y.; Miller, L.G.; Longhurst, G.R.; Masson, L.S.; Kulcinski, G.L. (Idaho National Engineering Lab., Idaho Falls (USA); Wisconsin Univ., Madison (USA)). 1980. Contract AC07-76ID01570. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The concept presented makes use of the fast spectrum in the Engineering Test Reactor (ETR) at the Idaho National Engineering Laboratory (INEL). Preliminary results show that an asymmetric, nuclear test environment with particle and radiant energy fluxes impinging on a first wall/blanket or divertor surface appears feasible in a neutron/gamma field not greatly different from that seen by a representative first wall/blanket module.

37449 (DOE/ER—0046/1) **Damage analysis and fundamental studies. Quarterly progress report, January-March 1980.** (Department of Energy, Washington, DC (USA). Office of Fusion Energy). May 1980. 276p. NTIS, PC A13/MF A01.

The DAFS program element is a national effort composed of contributions from a number of National Laboratories and other government laboratories, universities, and industrial laboratories. It was organized by the Materials and Radiation Effects Branch, Office of Fusion Energy, DOE, and a Task Group on Damage Analysis and Fundamental Studies which operates under the auspices of that Branch. The purpose of this series of reports is to provide a working technical record of that effort for the use of the program participants, for the fusion energy program in general, and for the Department of Energy. This report is organized along topical lines in parallel to a Program Plan of the same title so that activities and accomplishments may be followed readily, relative to that Program Plan. Thus, the work of a given laboratory may appear throughout the report. The Table of Contents is annotated for the convenience of the reader.

37450 (SAND—80-1184) **Retention, isotope exchange, and thermal release of hydrogen in candidate materials for TFTR.** Wampler, W.R.; Doyle, B.L.; Brice, D.K.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

The materials studied included TiC, TiB_2, VB_2, B_4C, B, Si, graphite, and the metals Ti, V, and 304L stainless steel. The TiC and TiB_2 were formed by chemical vapor deposition on a graphite substrate. The C/Ti ratio of the TiC was measured to be 1.0 +- .05 by ion backscattering analysis. The Ti and V were explosively bonded to copper substrates, and the VB_2 was made by borodizing vanadium. Carbon (compression annealed pyrolytic graphite from Union Carbide and Papyex graphite ribbon from Le Carbone) and single crystal silicon samples were included in the study as reference materials. The hydrogen retention and isotope exchange behavior for these materials were studied by measuring the amount of H or D retained as a function of incident fluence using the D(^{3}He,P)^{4}He nuclear reaction analysis techniques for D and H(^{15}N,$\alpha\gamma$) profiling for H.

37451 (SAND—80-1902C) **Pulsed neutron generator for use with pulsed neutron activation techniques.** Rochau, G.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-801053—1). NTIS, PC A02/MF A01.

From 8. water reactor safety research information meeting; Gaithersburg, MD, USA (27 Oct 1980).

A high-output, transportable, pulsed neutron generator has been developed by Sandia National Laboratories for use with Pulsed Neutron Activation (PNA) techniques. The PNA neutron generator generates > 10^{10} 14 MeV D-T neutrons in a 1.2 millisecond pulse. Each operation of the unit will produce a nominal total neutron output of 1.2 x 10^{10} neutrons. The generator has been designed to be easily repaired and modified. The unit requires no additional equipment for operation or measurement of output.

37452 (SAND—80-2051C) **Mechanical properties of chemical vapor deposited coatings for fusion reactor application.** Mullendore, A.W.; Whitley, J.B.; Pierson, H.O.; Mattox, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 18p. (CONF-801037—13). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Chemical vapor deposited coatings of TiB_2, TiC and boron on graphite substrates are being developed for application as limiter materials in magnetic confinement fusion reactors. In this application severe thermal shock conditions exist and to do effective thermomechanical modelling of the material response it is necessary to acquire elastic moduli, fracture strength and strain to fracture data for the coatings. Four point flexure tests have been conducted from room temperature to 2000°C on TiB_2 and boron coated graphite with coatings in tension and compression and the mechanical properties extracted from the load-deflection data. In addition, stress relaxation tests from 500 to 1150°C were performed on TiB_2 and TiC coated graphite beams to assess the low levels of plastic deformation which occur in these coatings. Significant differences have been observed between the effective mechanical properties of the coatings and literature values of the bulk properties.

GENERAL AND MISCELLANEOUS

MANAGEMENT

37453 (BNL—51164) **Staff roster for 1979-Energy Sciences programs.** Manowitz, B.; Gurinsky, D.H. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 82p. NTIS, PC A05/MF A01.

This publication lists the education, research interests, professional affiliations, committee memberships, research experience, and selected publications of BNL staff members in energy sciences programs. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 36175, 36978, 37150, 37299

37454 (AD-A—077102) **A Newton method for the PIES energy model. Technical summary report.** Josephy, N.H. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jun 1979. Contracts DAAG29-75-C-0024;NSF-MCS74-20584. 33p. NTIS, PC A03/MF A01.

Newton's method is a well known and often applied technique for computing a zero of a nonlinear function. By using the theory of generalized equations, a Newton method has been developed to solve problems arising in both mathematical programming and mathematical economics. It is shown how Newton's method for generalized equations can be applied to the economic equilibrium problem of the Project Independence Evaluation System (PIES) Energy Model. Solutions to a simplified version of PIES are obtained using a Newton method, and comparisons are made to solutions which have appeared in the literature.

37455 (COO—1340-77) **Concept of a (1-α) performance confidence interval.** Leong, H.H.; Johnson, G.R.; Bechtel, T.N. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1980. Contract AS02-76EV01340. 28p. (CONF-801049—1). NTIS, PC A03/MF A01.

From 1980 international conference of cybernetics and systems; Cambridge, MA, USA (8 Oct 1980).

A multi-input, single-output system is assumed to be represented by some model. The distribution functions of the input and the output variables are considered to be at least obtainable through experimental data. Associated with the computer response of the model corresponding to given inputs, a conditional pseudoresponse set is generated. This response can be constructed by means of the model by using the simulated pseudorandom input variates from a neighborhood defined by a preassigned probability allowance. A pair of such pseudoresponse values can then be computed by a procedure corresponding to a (1-α) probability for the conditional pseudoresponse set. The range defined by such a pair is called a (1-α) performance confidence interval with respect to the model. The application of this concept can allow comparison of the merit of two models describing the same system, or it can detect a system change when the current response is out of the performance interval with respect to the previously identified model. 6 figures.

37456 (ORNL/TM—7504) **Development and comparison of algorithms for generating a scan sequence for a random access scanner.** Eason, R.O. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 169p. NTIS, PC A08/MF A01.

Many data acquisition systems incorporate high-speed scanners to convert analog signals into digital format for further processing. Some systems multiplex many channels into a single scanner. A random access scanner whose scan sequence is specified by a table in random access memory will permit different scan rates on different channels. Generation of this scan table can be a tedious manual task when there are many channels (e.g. 50), when there are more than a few scan rates (e.g. 5), and/or when the ratio of the highest scan rate to the lowest scan rate becomes large (e.g. 100:1). An algorithm is developed which will generate these scan sequences for the random access scanner and implements the algorithm on a digital computer. Application of number theory to the mathematical statement of the problem led to development of several algorithms which were implemented in FORTRAN. The most efficient of these algorithms operates by partitioning the problem into a set of subproblems. Through recursion they solve each subproblem by partitioning it repeatedly into even smaller parts, continuing until a set of simple problems is created. From this process, a pictorial representation or wheel diagram of the problem can be constructed. From the wheel diagram and a description of the original problem, a scan table can be constructed. In addition, the wheel diagram can be used as a method of storing the scan sequence in a smaller amount of memory. The most efficient partitioning algorithm solved most scan table problems in less than a second of CPU time. Some types of problems, however, required as much as a few minutes of CPU time. 26 figures, 2 tables.

37457 (UCRL—84577) **Network user services and personnel issues.** Luk, C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jun 1980. Contract W-7405-ENG-48. 7p. (CONF-801105—2). NTIS, PC A02/MF A01.

From 8. annual user services conference; Morgontown, WV, USA (16 Nov 1980).

In a network environment, users are remote from the computer center. User services personnel, being the initial and possibly the only contact, represent the computer center to the users. Conversely, they must represent the view of the users to exert the proper influence on the operation of the computer center. With timesharing, users have close contact and scrutiny of system software. This user intimate software should be developed and maintained by user services. Personnel issues for these expanded user services are discussed: staffing, organization, recruiting, training, appraisal, and work satisfaction.

37458 **Methods for numerical conformal mapping.** Menikoff, R.; Zemach, C. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Comput. Phys.;* **36**: No. 3, 366-410(15 Jul 1980).

Nonlinear integral equations for the boundary functions which determine conformal transformations in two dimensions are developed and analyzed. One of these equations has a nonsingular logarithmic kernel and is especially well suited for numerical computations of conformal maps including those which deal with regions having highly distorted boundaries. Numerical procedures based on interspersed Gaussian quadrature for approximating the integrals and a Newton—Raphson technique to solve the resulting nonlinear algebraic equations are described. The Newton—Raphson iteration converges reliably with very crude initial approximations. Numerical examples are given for the mapping of a half-infinite region with periodic boundary onto a half plane, with up to nine-figure accuracy for values of the map function on the boundary and for its first derivatives. The examples include regions bounded by "spike" curves characteristic of Rayleigh—Taylor instability phenomena. A differential equation is derived which relates changes of the boundary. This is relevant to potential problems for regions with time-dependent boundaries. Further nonsingular integral formulas are derived for conformal mapping in a variety of geometries and for application to the boundary-value problems of potential theory.

37459 **Numerical divergence of a tensor.** Hicks, H.R.; Wooten, J.W. *J. Comput. Phys.;* **36**: No. 3, 411-416(15 Jul 1980).

It is shown that a Cartesian basis for the uncontructed components of a tensor yields a six-point instead of a seven-point function. (AIP)

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Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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CONF-800743-	(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)	
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CONF-800765-	(7. LLR/MMRD international symposium of interfaces in glass-metal systems, Berkeley, CA, USA, 28 Jul-1 Aug 1980)	
2	5:36953	*See* LBL-11392
CONF-800768-	(5. international conference on spectral line shapes, Berlin, F.R. Germany, 7-11 Jul 1980)	
1	5:37390	*See* PPPL-1686
CONF-800802-	(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)	
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CONF-800804-	(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)	
22	5:36653	NTIS, PC A03/MF A01
CONF-800806-	(15. intersociety energy conversion engineering conference, Seattle, WA, USA, 18-22 Aug 1980)	
34	5:36668	NTIS, PC A02/MF A01
39	5:36798	*See* SERI/TP-731-756
CONF-800814-	(180. American Chemical Society meeting/2. chemical congress of the North American Continent, Las Vegas, NV, USA, 24-29 Aug 1980)	
15	5:37030	NTIS, PC A03/MF A01
18	5:37112	NTIS, PC A02/MF A01
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21(Draft)	5:37031	NTIS, PC A02/MF A01
23(Draft)	5:37032	NTIS, PC A02/MF A01
CONF-800820-	(American Statistical Society meeting, Houston, TX, USA, 11-14 Aug 1980)	
10	5:36663	*See* HEDL-SA-2100-FP
CONF-800862-	(21. congress of International Association of Theoretical and Applied Limnology, Kyoto, Japan, 24-31 Aug 1980)	
1	5:37176	NTIS, PC A02/MF A01
CONF-800865-	(Annual solar energy program review, Rockport, ME, USA, 26-28 Aug 1980)	
1	5:36582	*See* DOE/NASA/23139-1
CONF-800866-	(10. international seaweed symposium, Gothenburg, Sweden, Aug 1980)	
1	5:36330	Corona del Mar, CA; California Institute of Technology (1980).
CONF-800867-	(Symposium on energy and ecology in the West, Tucson, AZ, USA, 4 Aug 1980)	
2	5:36292	*See* SERI/TP-743-826
CONF-800869-	(Quadrennial international ozone symposium, Boulder, CO, USA, 4-9 Aug 1980)	
1	5:37141	*See* UCRL-84058
CONF-800870-	(10. international conference on electromagnetic isotope separators, Zinal, Switzerland, 31 Aug-6 Sep 1980)	
2	5:37033	NTIS, PC A03/MF A01
CONF-800872-	(International astronomical union colloquium 58 on stellar hydrodynamics, Los Alamos, NM, USA, Aug 1980)	
2	5:37269	*See* LA-UR-80-2732
CONF-800932-	(2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas, Como, Italy, 3-12 Sep 1980)	
4	5:37372	*See* GA-A-15984
5	5:37369	NTIS, PC A02/MF A01
CONF-800939-	(International congress on transportation, Dearborn, MI, USA, 15-17 Sep 1980)	
1	5:36879	*See* DOE/NASA/1011-32
CONF-800942-	(ANS topical meeting on 1980 advances in reactor physics and shielding, Sun Valley, ID, USA, 14-17 Sep 1980)	
2	5:36644	NTIS, PC A02/MF A01
3	5:36664	NTIS, PC A02/MF A01
5	5:36671	NTIS, PC A02/MF A01
6	5:36645	NTIS, PC A02/MF A01
CONF-800943-	(National topical meeting of fuel cycles for the 80's, Gatlinburg, TN, USA, 29 Sep-2 Oct 1980)	
6	5:36666	NTIS, PC A02/MF A01
8	5:36079	*See* DP-MS-80-11
9	5:36089	*See* DP-MS-80-31
10	5:36053	*See* DP-MS-80-5
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6	5:37438	*See* UCRL-84826
7	5:37427	NTIS, PC A02/MF A01
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1	5:37045	*See* UCRL-84311
CONF-800957-	(3. annual Madison conference of applied research and practice on municipal and industrial waste, Madison, WI, USA, 10-12 Sep 1980)	
1	5:35869	NTIS, PC A02/MF A01
CONF-800960-	(Western regional conference on gold, silver, uranium and coal, Rapid City, SD, USA, 18-20 Sep 1980)	
1	5:36047	NTIS, PC A03/MF A01
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1	5:36905	*See* SAND-80-1617C
CONF-800963-	(5. international photosynthesis congress, Kassandra-Halkidiki, Greece, 7-13 Sep 1980)	
2	5:37186	*See* BNL-28300
CONF-800964-	(National symposium on the use of cesium-137 to process sludge for further reduction of pathogens, Denver, CO, USA, 3-4 Sep 1980)	
2	5:37222	*See* SAND-80-7124C
CONF-800966-	(Conference on waste heat recovery for energy conservation: residential and light commercial heat pumps, West Lafayette, IN, USA, 15-17 Sep 1980)	
1	5:36823	NTIS, PC A02/MF A01
CONF-800972-	(1980 Department of Energy passive and hybird solar energy program update meeting, Washington, DC, USA, 21-24 Sep 1980)	
1	5:36808	NTIS, PC A02/MF A01
2	5:36478	*See* LA-UR-80-2687
4	5:36477	*See* LA-UR-80-2556
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2	5:36201	*See* BNL-28297
CONF-800976-	(Meeting on miniaturization of high energy physics detectors, Pisa, Italy, 18-20 Sep 1980)	
1	5:37106	*See* BNL-28279
CONF-800977-	(ACS symposium series on oil shale, tar sands, and related materials, Pittsburgh, PA, USA, 30 Sep 1980)	
1	5:36006	*See* UCRL-84066
CONF-800979-	(Workshop on nuclear data evaluation methods and procedures, Upton, NY, USA, 22-25 Sep 1980)	
2	5:37344	NTIS, PC A02/MF A01
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2	5:37430	*See* UCRL-84108
3	5:37049	*See* UCRL-84110
4	5:37047	*See* LA-UR-80-2731
7	5:37048	*See* LA-UR-80-2774
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2	5:36097	NTIS, PC A02/MF A01
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5	5:36691	*See* LA-UR-79-3019
7	5:36683	NTIS, PC A02/MF A01
8	5:36702	*See* SAND-79-0931C
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3	5:37115	*See* SAND-80-1815C
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13	5:37452	*See* SAND-80-2051C
14	5:36936	*See* SAND-80-2077C
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1	5:37180	*See* Y/DK-255
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6	5:36965	*See* SAND-80-0964C
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1	5:37455	*See* COO-1340-77
CONF-801051-	(75. SAE anniversary aerospace congress, Los Angeles, CA, USA, 13-16 Oct 1980)	
1	5:37040	*See* SAND-80-2034C
CONF-801052-	(Society for Experimental Stress Analysis meeting, Ft Lauderdale, FL, USA, 12-17 Oct 1980)	
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CONF-801053-	(8. water reactor safety research information meeting, Gaithersburg, MD, USA, 27-31 Oct 1980)	
1	5:37451	*See* SAND-80-1902C
CONF-801054-	(Institute for Reactor Safety meeting, Munich, F.R. Germany, 31 Oct 1980)	
1	5:36673	*See* SAND-80-1837C
CONF-801059-	(32. meeting of the mechanical failures prevention group, Santa Monica, CA, USA, 7-9 Oct 1980)	
1	5:36553	*See* SAND-80-2026C
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1	5:36937	*See* SAND-80-8033
CONF-801063-	(International symposium on the impacts of radionuclide releases into the marine environment, Vienna, Austria, 6-10 Oct 1980)	
1	5:37226	*See* UCRL-84213
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2	5:37074	*See* SAND-79-2377C
3	5:36601	*See* SAND-80-0475C
5	5:36491	*See* SAND-80-0385C

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20	5:36949	*See* SAND-80-0494C
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28	5:36140	*See* RHO-SA-160
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2	5:37111	*See* BNL-27919
3	5:37386	*See* LA-UR-80-1906
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3	5:36977	*See* K/ET-5009
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10	5:36094	*See* SAND-80-1633C
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3	5:37114	*See* SAND-80-1793C
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3	5:37148	*See* LA-UR-80-2604
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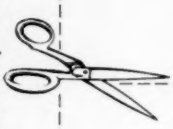

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